A NATURAL RESOURCE SURVEY OF THE MELVILLE HILLS REGION, NORTHWEST TERRITORIES

S.C. Zoltai
J. Sirois
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TECHNICAL REPORT SERIES No. 135
Western & Northern Region **1992**
Canadian Wildlife Service

Environment Canada | Environnement Canada
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92-07064/

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This report may be cited as:

Zoltai, S.C., J. Sirois and G.W. Scotter. 1992. A natural resource survey of the Melville Hills region, Northwest Territories. Technical Report Series No. 135. Canadian Wildlife Service, Western and Northern Region, Yellowknife.

Issued under the Authority of the
Minister of Environment
Canadian Wildlife Service

Minister of Supply and Service Canada 1992
Catalogue No. CW69-5/135E
ISBN 0-662-18942-6
ISSN 0831-6481

Copies may be obtained from:

Canadian Wildlife Service
Western & Northern Region
Environment Canada
P.O. Box 637
Yellowknife, NWT
X1A 2N5

ABSTRACT

The Canadian Parks Service identified the Melville Hills area for consideration as a potential National Park. In July 1990, the Canadian Wildlife Service and Forestry Canada carried out an overview study of the natural resources of the area at the request of the Canadian Parks Service. The objectives of the study were:

1. To describe the geology, physical geography, flora, and fauna of the study area.
2. To map and classify the broad vegetation types and ecological units of the study area.
3. To identify outstanding features of the area that might be critical to the management of a National Park.

The study is based primarily on a review of existing information, and on interpretation of aerial photographs, supported by ten days of field work.

This report discusses the climate, bedrock geology, glacial geology, permafrost and periglacial phenomena, soils, physiography, vegetation, flora, ecological land classification, mammals, birds, and fishes of the Melville Hills area. One ecodistrict lies within the Mid-Arctic Ecoclimatic region and five ecodistricts are in the Low Arctic Ecoclimatic Region. Plant and animal checklists include bryophytes (103 species), lichens (158 species), and vascular plants (239 species); mammals (22 confirmed, 18 possible species), birds (81 species) and fishes (21 species).

The biodiversity is high for an arctic area due to the presence of a variety of microhabitats. The central part of the area probably escaped glaciation and acted as a refugium for biota during the Wisconsinan glaciation. The Melville Hills region is a significant calving ground for the Bluenose caribou herd. The number of sheer cliffs in canyons and ramparts provide good nesting habitat for Peregrine Falcons and other birds of prey. Despite recent declines, the Arctic Char population of the Hornaday River is apparently the largest in the region.

The area is representative of the Tundra Hills Natural Region, and has a number of exceptional biological and physical attributes. Any decisions on possible park boundaries should take into account the calving of caribou and the nesting of birds of prey, as well as the diverse vegetation of the lower Hornaday and Brock river valleys.

RÉSUMÉ

Le Service canadien des parcs a identifié la région des collines de Melville comme site potentiel pour l'établissement d'un parc national. A la demande du Service des parcs, le Service canadien de la faune et Forêts Canada ont effectué un inventaire général des ressources naturelles de cette région en juillet 1990. Les objectifs de cet inventaire furent de:

1. Décrire la géologie, la géographie physique, la flore et la faune de la région.
2. Cartographier et classifier les principaux ensembles écologiques et végétaux de la région.
3. Identifier les caractéristiques exceptionnelles de la région dont il faudrait tenir compte dans la gestion d'un parc national.

Cet inventaire fut réalisé surtout grâce à la révision de nombreux documents et à l'aide de photographies aériennes. On a aussi passé 10 jours sur le terrain.

Ce rapport traite du climat, de la géologie, des formations glaciares et périglaciares, des sols, de la physiographie, de la végétation, de la flore, de la classification écologique du territoire, des mammifères, des oiseaux et des poissons de la région des collines de Melville. Un des écodistricts identifiés appartient à la région écoclimatique du moyen-Arctique alors que cinq autres écodistricts sont caractéristiques de la région écoclimatique du bas-Arctique. On a confirmé la présence d'au moins 103 espèces de bryophytes, 158 espèces de lichens, 239 espèces de plantes vasculaires, 22 espèces (et 18 espèces possibles) de mammifères, 81 espèces d'oiseaux et 21 espèces de poissons dans cette région.

La biodiversité de cette région arctique est grande et s'explique surtout par la présence de plusieurs micro-habitats. La partie centrale de la région a probablement été épargnée par la glaciation wisconsinienne, et elle aurait servi de refuge naturel aux biotes. La région des collines de Melville est un site de vêlage important pour la harde de caribous Bluenose. Les falaises escarpées et les canyons de la région offrent des sites de nidification excellents pour de nombreux couples de Faucons pèlerins et d'autres oiseaux de proie. Malgré que la population d'ombles chevaliers de la rivière Hornaday ait été récemment surpêchée, elle demeure l'une des plus grandes de la région.

Les collines de Melville sont typiques de la région naturelle des "collines de la toundra", telle que définie par le Service canadien des parcs, et elles possèdent un certain nombre de caractéristiques physiques et biologiques exceptionnelles. Les limites du parc devraient être déterminées en tenant compte de la protection des aires de vêlage des caribous, des sites de nidifications des oiseaux de proie et la riche végétation du cours inférieur des rivières Hornaday et Brock.

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1. INTRODUCTION

1.1 Purpose of Study

This study was carried out, at the request of Canadian Parks Service, to briefly summarize the existing knowledge of the natural resources of the Melville Hills region. In February of 1990, Canadian Parks Service asked the Canadian Wildlife Service and Forestry Canada to carry out an overview study of the natural resources of this area.

The study area covers approximately 33,000 km^2. It lies partly on sedimentary rocks of the Precambrian Shield and partly on younger sedimentary rocks, and is entirely within the Tundra Hills Natural Region (Region 15, Parks Canada 1972).

The objectives of this study are:

1. To describe the geology, physical geography, flora and fauna of the study area.
2. To map and classify the vegetation types and ecological units of the study area.
3. To identify outstanding features of the area that might be critical to the management of a National Park.

1.2 Scope of Study

This study is based primarily on a review of existing information and on interpretation of aerial photographs, supported by a brief period of field work.

This report focuses on the Melville Hills region as illustrated in Fig. 1.1. This region includes the proposed Bluenose National Park, in which Bluenose Lake is located (see Fig. 2.1). References are made to the Melville Hills region or more specifically to the proposed Bluenose National Park, Bluenose Lake area and other sites in the Melville Hills as needed, or as reported in the publications that we reviewed.

1.2.1 Field Research

Field research consisted of a helicopter-supported survey of the study area during July 24 - August 2, 1990 (Fig. 1.1). The itinerary included helicopter traverses of the study area. A total of 43 stops were made to examine the vegetation, soil, wildlife, and physiography, and to collect plant and soil samples. This was supplemented by foot traverses in the vicinity of the camp centrally located in the study area on a large lake (informally known as Hornaday Lake) at the headwaters of a major tributary (Little Hornaday River) of Hornaday River.

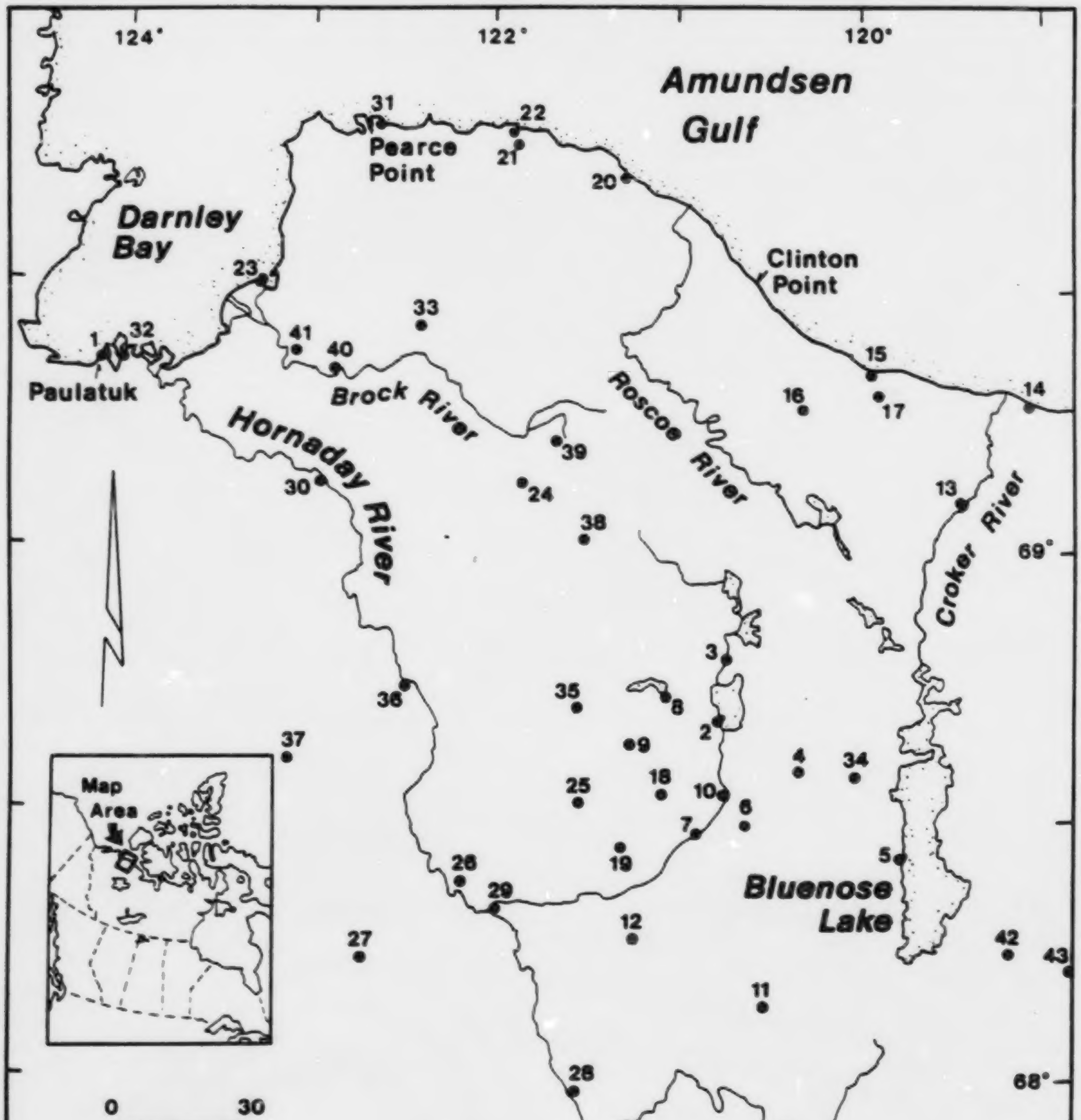
124°
122°
120°
69°
68°
Amundsen Gulf
Darnley Bay
Pearce Point
Clinton Point
Paulatuk
Brock River
Hornaday River
Roscoe River
Croker River
Bluenose Lake
Map Area
0
30
Kilometres
1
2
3
4
5
6
7
8
9
10
11
12
13
14
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Figure 1.1 Sites visited by the authors between July 24 and August 2, 1990

1.2.2 Office Studies

Office studies consisted of reviewing published literature and unpublished government files (all authors), and interviewing persons who have experience in the study area (Sirois). The collected plant specimens were identified (Scotter) and soil analyses were performed (Zoltai).

Zoltai interpreted the aerial photographs, established ecological land units and broad vegetation types, and mapped the study area at a scale of 1:250,000. Zoltai also summarized the information on physiography, geology, soils, hydrology, and described the broad vegetation types.

Sirois researched and summarized the literature on mammals, birds, fishes, and climate.

Scotter prepared the species lists for bryophytes, lichens, and vascular plants, and prepared the discussions on the flora. He acted as liaison between the contracting services and Canadian Parks Service.

1.3 Acknowledgements

We wish to acknowledge the assistance of W.J. Cody (Biosystematics Research Institute, Agriculture Canada, Ottawa), D.H. Vitt (Department of Botany, University of Alberta), and J.W. Thomson (Department of Botany, University of Wisconsin) with the identification of vascular plants, byrophytes, and lichens, respectively. C. Tarnocai (Land Resource Research Centre, Agriculture Canada, Ottawa) provided unpublished information on the soils of the area.

T. Green, a resident of Paulatuk, helped us operate our field camp and shared many insights based on his knowledge of the region. J. Obst, a resident of Yellowknife, provided much information on the avifauna. Several of his photographs were included in this report. D. Reid (Department of Zoology, University of British Columbia) generously reported to us all the bird and mammal sightings recorded at Pearce Point by J.C. Krebs' team since 1987.

A. Downey drafted the figures, and M. Regnier assembled the manuscript. M. Siltanen was instrumental in drafting the maps.

D. Harvey and G. Hamre (Canadian Parks Service) ably arranged the transportation and accommodation logistics, and were responsible for the successful field operation. They also provided Zoltai with aerial photographs and reviewed this report. Other reviewers include R.S. Ferguson and K.J. McCormick (Canadian Wildlife Service).

2. CLIMATE

Clinton Point (Fig. 2.1) is the closest weather station to the Melville Hills where a comprehensive set of climatic data has been compiled. A low-arctic climate prevails in this region, as indicated by a nearly continuous cover of dwarf tundra vegetation (Ecoregions Working Group 1989). In light of the immediate proximity of Amundsen Gulf, the coastal areas are largely influenced by maritime air masses. More continental conditions (e.g. less fog, less precipitation, larger fluctuations in temperatures) likely prevail along the southern limit of the proposed Bluenose National Park, which is 200 km inland.

In comparison to other arctic locales, and as suggested by Maxwell (1981), relatively moderate conditions prevail along the coast of Amundsen Gulf. Nonetheless, Phillips (1990) suggested that the regional Climate Severity Index (scale: 1 to 100) was 80, compared to 60 for Yellowknife and 37 for Edmonton. Usually, the waters of the Gulf are ice-free at the end of the summer, hence the relatively mild temperatures in coastal areas. Inland, particularly to the southwest, the nearby treeline (Fig. 2.1) suggests that subarctic conditions prevail there.

Sea ice conditions vary considerably from year to year. Only first-year ice usually occurs in the Gulf. Markham (1981) indicates that the coastline is usually ice-free by 23 July, and ice-bound by 22 October (Fig. 2.2). But it can be ice-free as early as late May, or as late as early August. Freeze-up occurs as early as mid-October, or as late as late October. Polynyas and lead systems, that provide ice-free water during the winter and spring, also develop near the coastline (Fig. 2.3; Stirling and Cleator 1981). During our visit (24 July - 2 August 1990), broken ice covered the marine waters off Clinton Point entirely to the horizon, but there was no ice off Pearce Point or in Darnley Bay.

Winters are cold and long in the Melville Hills with a mean daily temperature of -27.6°C in January (A.E.S 1982a). Summers are short and cool with a mean daily temperature of 7.4°C in July. Snowfall may occur throughout the summer, but total annual precipitation is low with an average of 181.5 mm (A.E.S. 1982a). The persistent snowcover season (> 2 cm) averages 250 days per year (Phillips 1990). The average annual number of days with blowing snow averages 60, compared to less than 10 at Yellowknife (Phillips 1990). The average annual number of days with fog is approximately 60, like the southern Beaufort Sea (Phillips 1990). Additional climatic data are presented in Table 2.1.

Recent evidence from a network of circumpolar weather stations (including stations at nearby Coppermine and Tuktoyaktuk) suggests that climate warming is affecting this region, as indicated by the earlier dates of snow disappearance in the spring in the last 20 years (Foster 1989).

Although not comparable to a mountain range, the Melville Hills constitute a significant topographical feature that may on occasion influence the regional climate. As indicated by locally luxuriant vegetation, milder micro-climates occur in numerous sheltered sites in valleys and canyons.

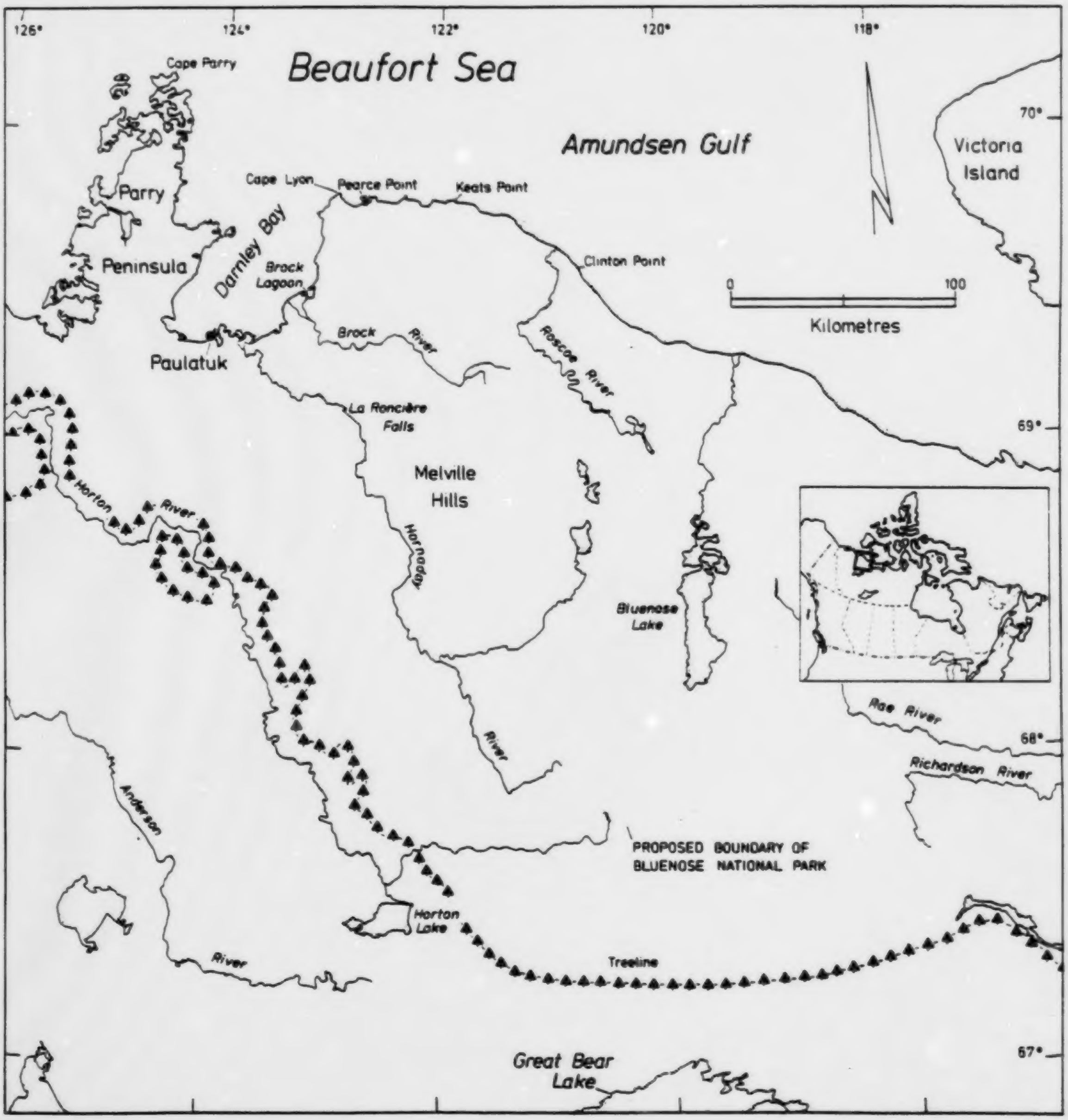
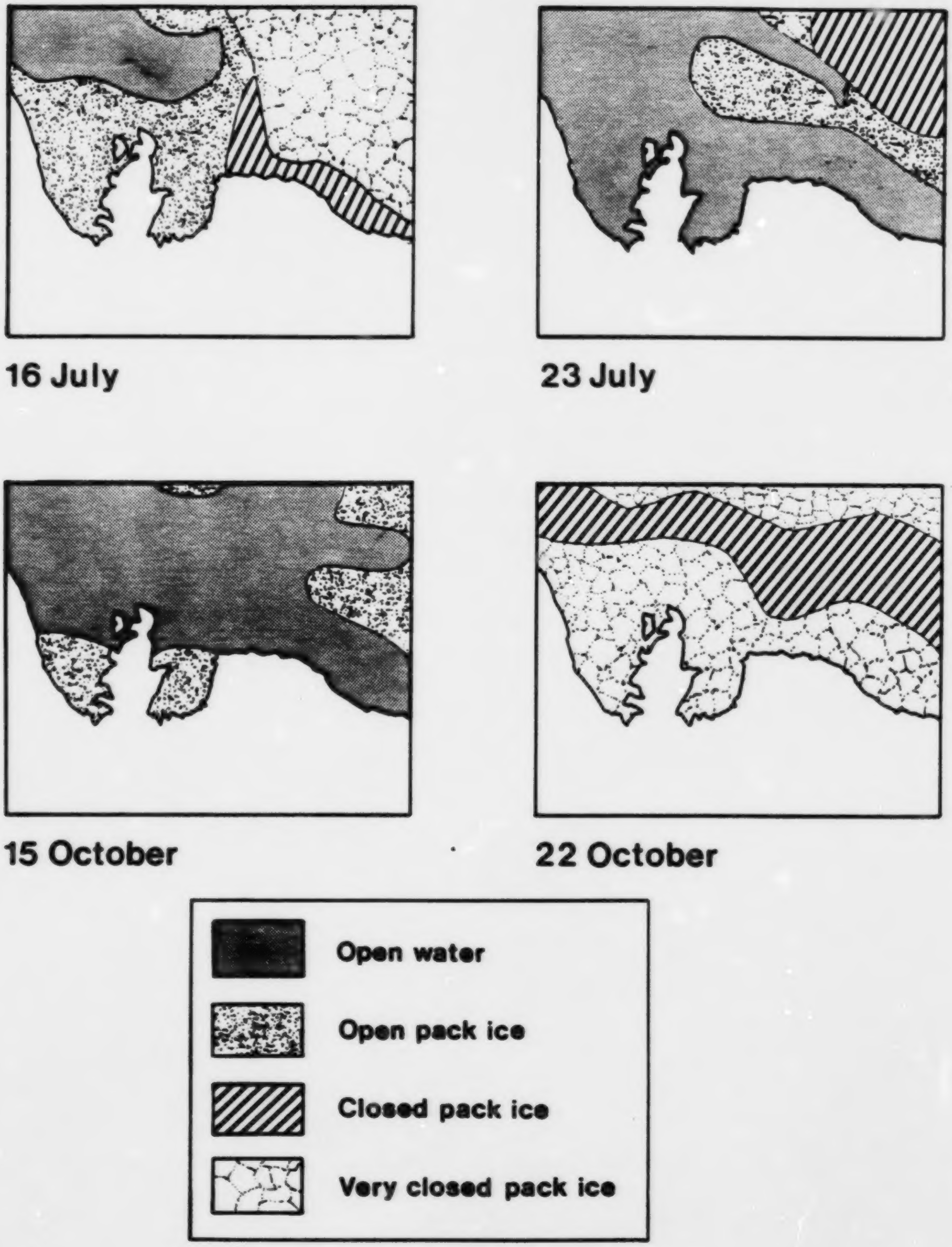

126°
124°
122°
120°
118°
Cape Parry
Beaufort Sea
Amundsen Gulf
70°
Victoria Island
Parry Peninsula
Cape Lyon
Pearce Point
Keats Point
Darnley Bay
Brock Lagoon
Clinton Point
0
100
Kilometres
Paulatuk
Brock River
Roscoe River
La Roncière Falls
69°
Melville Hills
Horton River
Hornaday River
Bluenose Lake
Rae River
68°
Richardson River
Anderson River
PROPOSED BOUNDARY OF BLUENOSE NATIONAL PARK
Horton Lake
Treeline
67°
Great Bear Lake

Figure 2.1 Location of the Melville Hills and the proposed Bluenose National Park



16 July

23 July

15 October

22 October

Open water
Open pack ice
Closed pack ice
Very closed pack ice

Figure 2.2 Median ice conditions at break-up and freeze-up

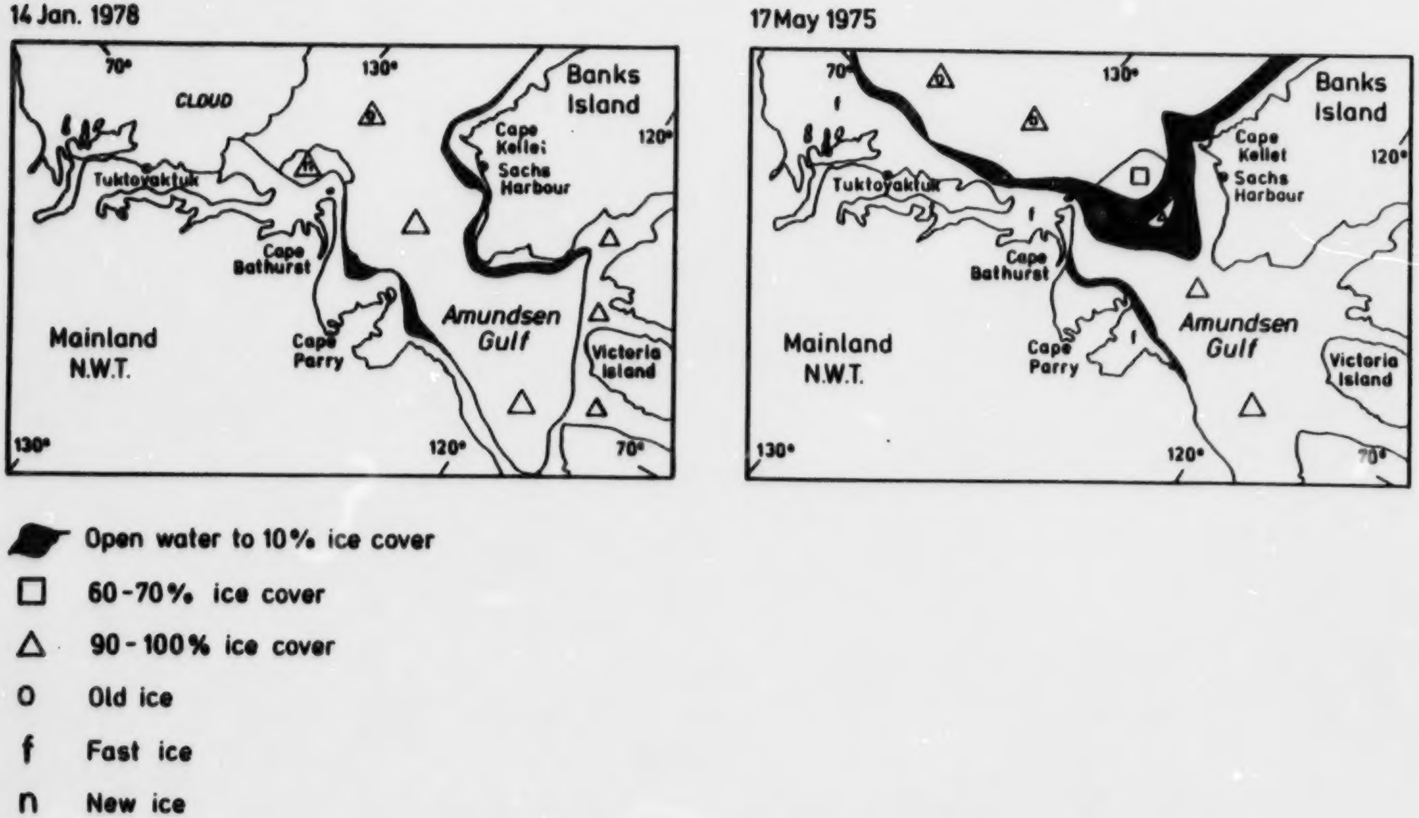

14 Jan. 1978
70°
CLOUD
130°
Banks
Island
Cape
Kellet
Sachs
Harbour
120°
Tuktoyaktuk
Cape
Bathurst
Mainland
N.W.T.
Cape
Parry
Amundsen
Gulf
Victoria
Island
130°
120°
70°
17 May 1975
70°
130°
Banks
Island
Cape
Kellet
Sachs
Harbour
120°
Tuktoyaktuk
f
Cape
Bathurst
Mainland
N.W.T.
Cape
Parry
Amundsen
Gulf
Victoria
Island
130°
120°
70°
Open water to 10% ice cover
□ 60-70% ice cover
△ 90-100% ice cover
o Old ice
f Fast ice
n New ice

Figure 2.3 Examples of polynyas and lead systems in Amundsen Gulf

Table 2.1 Annual and monthly climatic data for Clinton Point or Cape Parry, NWT, 1951-1980.

	Year	J	F	M	A	M	J	J	A	S	O	N	D
Total precipitation (mm) and days with precipitation													
Clinton Point	181.5 68	5.1 3	2.7 2	4.6 3	10.1 4	10.7 5	16.4 5	28.7 7	35.2 9	29.4 10	20.3 9	10.9 7	7.4 4
Mean rainfall (mm) and days with rain													
Clinton Point	96.6 26	0 0	0 0	0 0	0 0	2.7 1	13.9 4	28.5 7	34.4 8	16.3 5	0.8 1	0 0	0 0
Mean snowfall (cm) and days with snow													
Clinton Point	85.0 44	5.1 3	2.7 2	4.6 3	10.1 4	8.0 4	2.5 1	0.2 *	0.8 1	13.2 6	19.5 9	10.9 7	7.4 4
Mean daily temperature (℃)													
Clinton Point	-11.4	-27.6	-27.6	-25.7	-17.4	-5.9	3.0	7.4	6.6	0.9	-7.1	-17.7	-23.4
Mean maximum daily temperature (℃)													
Clinton Point	-7.9	-24.0	-24.0	-22.0	-13.6	-2.5	6.3	11.3	9.7	3.2	-4.5	-14.6	-20.0
Mean minimum daily temperature (℃)													
Clinton Point	-14.5	-31.1	-31.4	-29.5	-21.0	-9.2	-0.3	3.5	3.2	-1.5	-9.6	-20.7	-26.6
Mean wind speed (km/h) and prevailing direction													
Cape Parry	19.7 E	20.2 W	18.5 W	18.4 E	19.3 E	20.7 E	20.5 E	17.9 E	19.4 E	20.4 E	21.9 E	19.9 E	19.4 W

Average frost free period	Years of data	Period(day)	Last spring frost	First fall frost
Clinton Point	24	32	4 July	16 August

* Amounts less than 0.5 cm except zero.

Clinton Point: 69°35'N, 120°48'W; Cape Parry: 70°10'N, 124°41'W

Source: Atmospheric Environment Service 1982a, 1982b, 1982c.

3. HYDROLOGY

3.1 Streams and Standing Water

The largest part of the study area is drained by the Hornaday River and its tributaries. The river, some 350 km long, rises southwest of Bluenose Lake and flows around the south end of the Melville Hills, before turning north and emptying into Darnley Bay near Paulatuk. The river has one major tributary, the Little Hornaday River, which drains the south-central portion of the area. A number of smaller streams enter from the Melville Hills directly into Darnley Bay (Brock River) or into Amundsen Gulf, the larger of which are Roscoe River and Croker River, the latter being the outlet of Bluenose Lake.

All streams have developed deep and steep-sided canyons where they descend from the Melville Hills to the coastal plains (Fig. 3.1). The streams have countless rapids and falls within the canyons, such as La Roncière Falls on the Hornaday River (Fig. 3.2). The canyons are spectacular, with vertical walls rising up to 100 m above the stream. However, these rock-strewn stretches of the streams, flowing between the canyon walls, are virtually impassable by any craft, including canoes. Portaging would be possible only by completely bypassing the canyons. However, the Hornaday and Little Hornaday rivers, with a few minor rapids upstream of the canyon, should offer good opportunities for boating in their upper stretches.

The largest lake, Bluenose Lake, covers about 400 km^2. There are a number of sizeable lakes in its vicinity, occurring between morainic ridges. Another group of larger lakes occurs in the central part of the study area, including a lake that we called "Hornaday" Lake, and which drains south into the Hornaday River. On the central Melville Hills lakes or ponds are scarce, but many small ponds occur on the northern flanks of the Hills and on the coastlands.

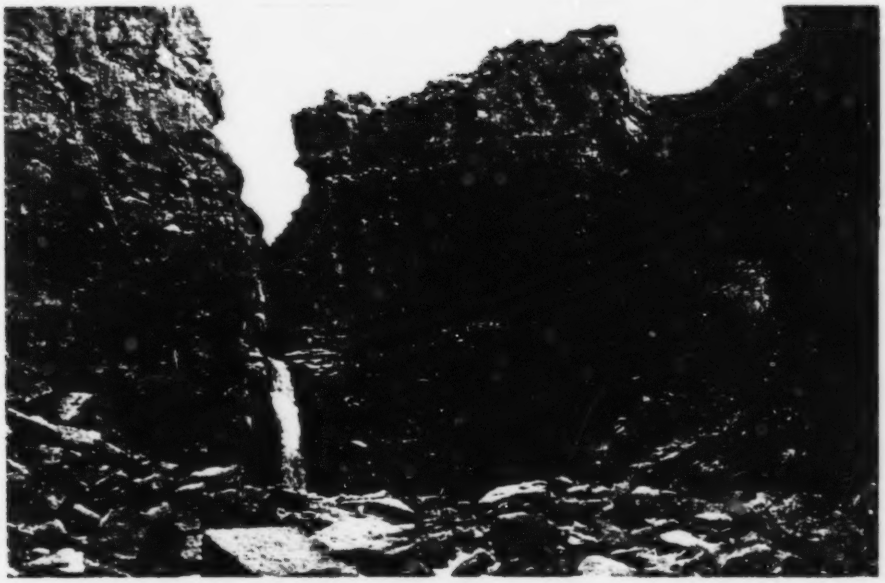


Figure 3.1 Canyon and falls on a small unnamed stream

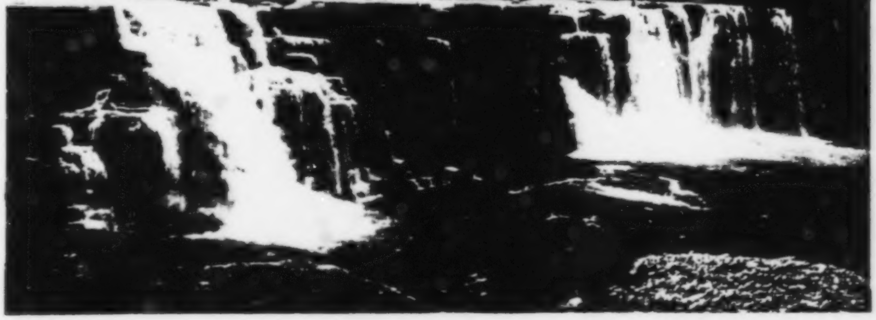


Figure 3.2 La Roncière Falls on the Hornaday River

4. BEDROCK GEOLOGY

4.1 Bedrock Stratigraphy

The bedrock geology of the study area has been described and mapped by Yorath et al. (1968), Cook and Aitken (1969) and Balkwill and Yorath (1970). The following outline is based on these studies.

Gently folded, unmetamorphosed Upper Proterozoic sedimentary rocks, composed largely or entirely of marine strata, underlie the central part of the study area (Fig. 4.1). The oldest strata (Neohelikian or Hadrynian), composed of dark grey-green shale, argillite and siltstone, outcrop along Darnley Bay. These are overlain unconformably by a sequence of lithographic units to a combined thickness of 1000 m. These units consist of a sequence of pink, grey to buff dolomite, poorly bedded sandstone and quartzite, and massive buff dolomite. These rocks outcrop at the surface along the Amundsen Gulf shoreline, and on the Melville Hills as far south as the Little Hornaday River. Quartzite is the dominant bedrock in the northern part of the Melville Hills. All these sedimentary units are intruded by dykes and sills of dark gabbro or diabase dykes and sills.

The Precambrian strata are overlain unconformably by sedimentary rocks of Paleozoic age, outcropping mainly along the mid-portion of the Hornaday River and in the southeastern part of the study area. The oldest of these, the Cambrian age formation, consists of sequences of friable sandstone, green to red shale, siltstone, mudstone and dolomite, with minor gypsum. Fossils are very scarce, and consist of stromatolites and burrows, indicating a marine origin of these strata. The combined thickness of the Cambrian formations is about 160 m.

The Cambrian strata are overlain by Upper Cambrian and Lower Ordovician members of the "Ronning Group", consisting mainly of dolomite. These rocks outcrop in the southeastern part of the study area and in an extensive area west of the Hornaday River. They are moderately resistant, generally light to medium grey and buff in colour, with laminations in the lower beds and abundant chert in the upper part. These rocks are sparsely fossiliferous. Poorly preserved silicified corals and stromatoporoids may occur in cherty dolomite beds. The combined thickness of the Ronning Group is estimated at 400 m.

Lower Cretaceous bedrock is exposed near the mouth of the Hornaday River and at isolated exposures in the northeastern part of the area. These rocks consist of soft shale and mudstone, with beds of friable sandstone. Fossils, such as poorly lignified coal and pelecypod shells are locally common. The combined thickness of the Cretaceous strata is estimated at over 200 m.

The most recent strata consist of Quaternary glacial deposits. They are the most prominent on the northern flanks of the Melville Hills and either side of Bluenose Lake where they form a broad morainic belt. Ground moraine appears to be absent from the central part of the Melville Hills, but is common elsewhere. Thick deposits of glaciofluvial sand and gravel are found in glacial meltwater channels. Small pockets of marine sediments occur at some locations near the present marine coastine. Small, shallow (1-2 m thick) peat deposits can be found in poorly drained depressions.

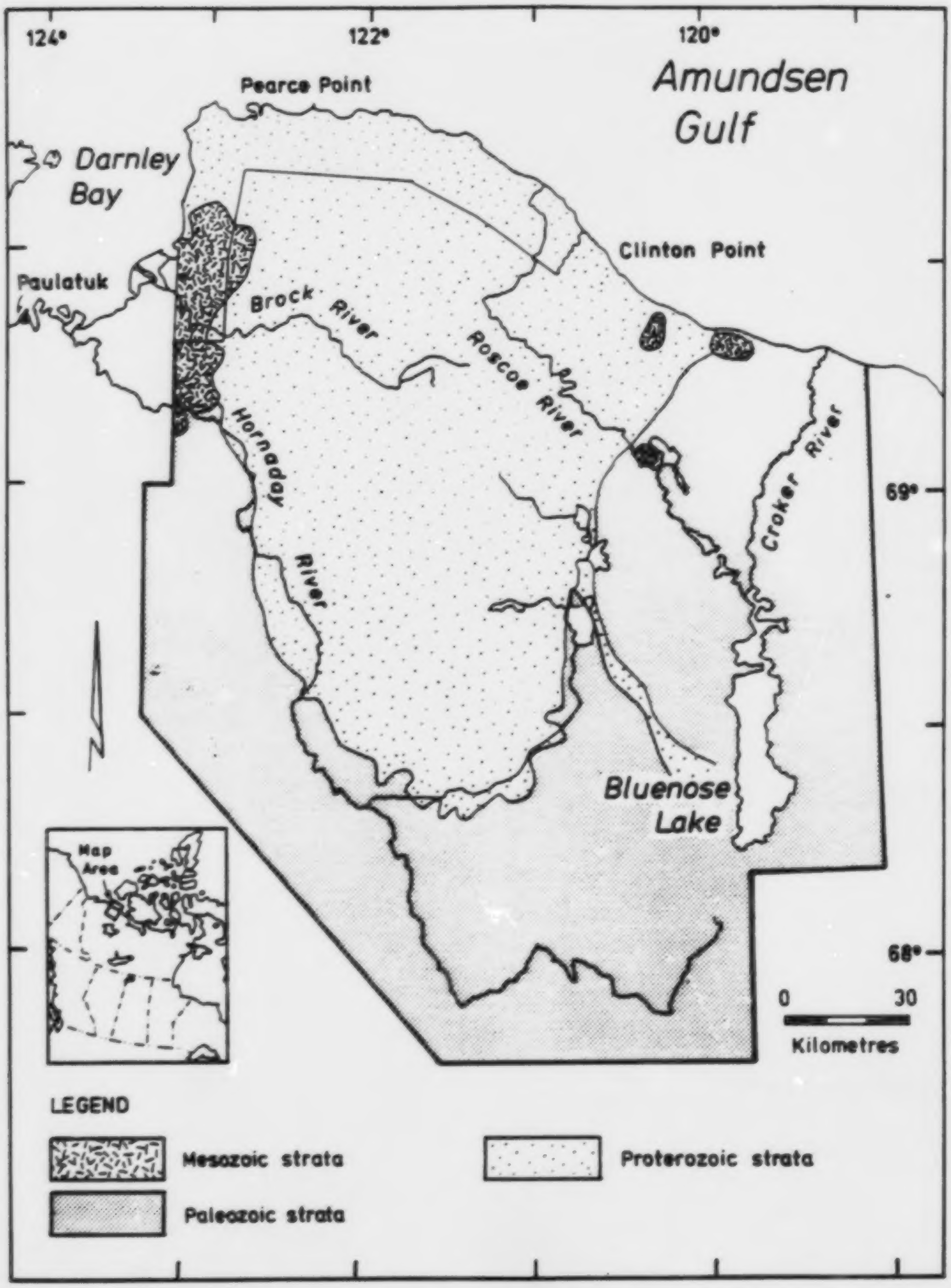

124°
122°
120°
Amundsen Gulf
Pearce Point
Darnley Bay
Paulatuk
Clinton Point
Brock River
Roscoe River
Hornaday River
Croker River
Bluenose Lake
69°
68°
0
30
Kilometres
Map Area
LEGEND
Mesozoic strata
Proterozoic strata
Paleozoic strata

Figure 4.1 Broad bedrock geology

4.2 Economic Geology

The assessment of mineral resources of the area is the subject of a separate study. Initial results do not indicate significant mineral deposits in the study area (Jones _et_ _al_. 1991).

5. GLACIAL GEOLOGY

5.1 Glacial History

The easternmost portion of the area (east of Long. 120°) has been recently investigated in detail by the Geological Survey of Canada (St-Onge and McMartin 1987, McMartin and St-Onge 1990). The surficial geology of the Brock River mapsheet was mapped by Klassen (1971). The following summary is based on these reports and on observations made during the field survey.

The central part of the study area, occupying the highest portions of the Melville Hills, are completely devoid of glacial landforms (Fig. 5.1). Here the surface features indicate a mature landscape, with gentle slopes, and a well-established drainage system that allows few lakes or ponds. The ground was searched for glacial erratics during the field survey, only three cobble-sized, well rounded erratics (crystalline igneous rocks) were found in the southern part of this area.

To the southeast of the main Melville Hills lies an area where numerous deglaciation features occur, but there are no landforms that indicate actively flowing ice. Here, small conical gravel hills (kames) abound (Fig. 5.2), often surrounded by silty deposits. In addition to the kames, outwash plains and abandoned deltas can also be found, usually severely dissected by eroded ice wedge polygons. Crystalline igneous rock erratics are common. This area appears to be the westerly extention of the kame and silt mound complex (St. Onge and McMartin 1987), interpreted as the disintegration products of an inactive ice sheet.

A large amount of wood occurs on the eastern shore of "Hornaday" Lake (Fig. 5.3), within 1 m above the lake level. The source of the wood is unknown, as the wood appears to come from beneath the lake. The wood looks fresh and it floats readily on water, indicating that it did not originate from a waterlogged deposit. Six pieces of wood were identified by the Geological Survey of Canada (GSC), five were _Picea_ sp. and one was "_Pinus_ _strobus_ type". The latter species presently occurs in southern Canada, in the Great Lakes region. Radiocarbon analyses were performed by the GSC on three pieces of wood, but all were beyond the range of the dating technique (>41,000 yrs B.P.). It is our understanding that the GSC is currently investigating this site.

A large morainic complex, extending north-south along the eastern shore of Bluenose Lake, marks the westerly advance of active ice. A similar morainic complex has accumulated along the northern flanks of Melville Hills, marking the southern extent of an ice advance. These morainic complexes were formed by an ice movement that enveloped the Melville Hills both to the southwest and northwest, as shown by the orientation of drumlinoid and esker features. Large meltwater channels are associated with this ice movement, the Roscoe-Brock channel in the north and the Hornaday channel in the south.

Two late ice advances are marked by fields of drumlins. One advanced from the Amundsen Gulf from the northeast, covering the northwestern part of the area, impinging on the Melville Hills. The other was a resurgence of ice flow

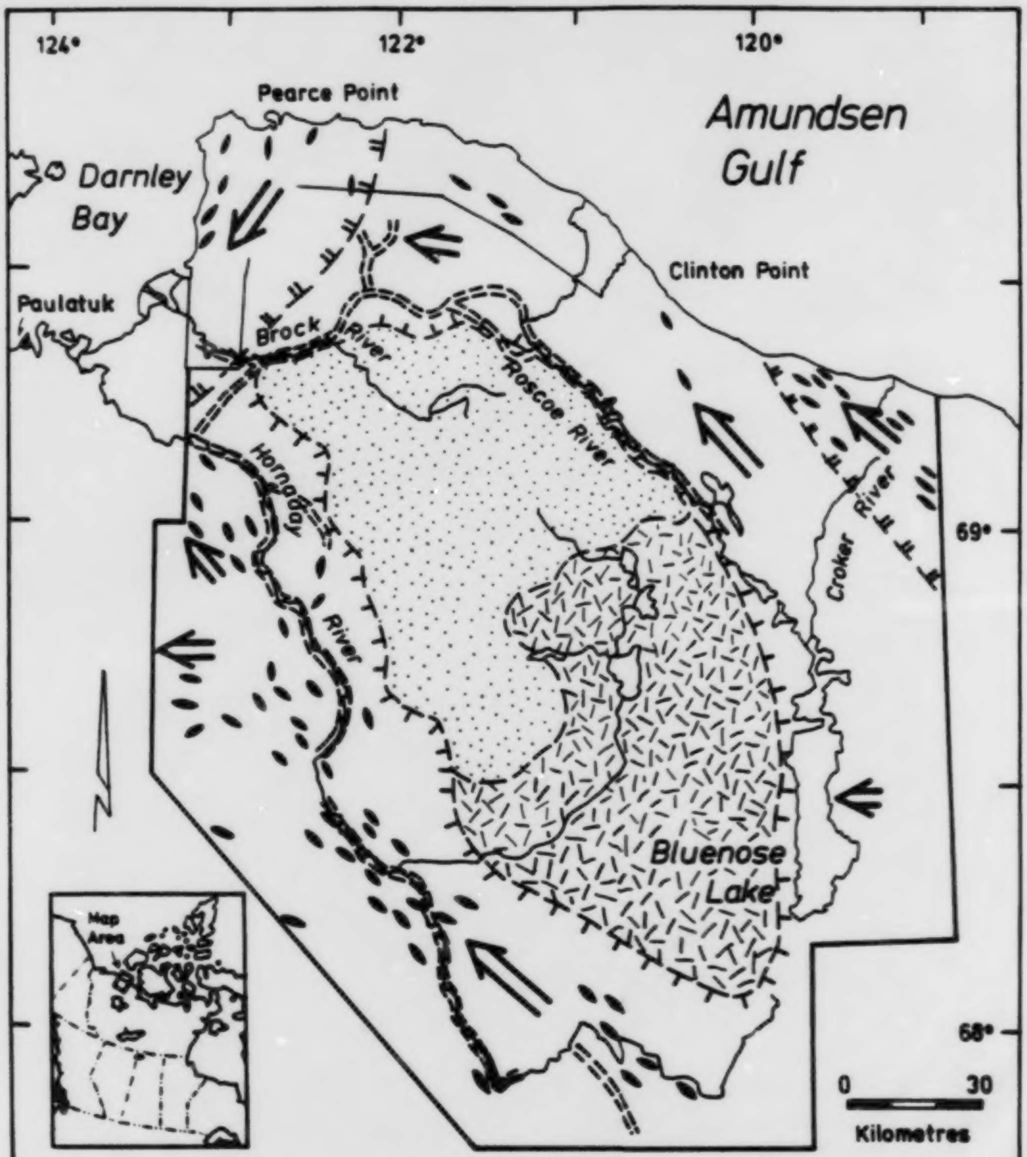

124°
122°
120°
Pearce Point
Amundsen Gulf
Darnley Bay
Paulatuk
Clinton Point
Brock River
Roscoe River
Hornaday River
Croker River
69°
68°
Bluenose Lake
Map Area
0
30
Kilometres
LEGEND
Active ice limit, early
Active ice limit, late
Scarce glacial deposits
Inactive ice area
Ice flow direction
Drumlinoids
Major glacial spillway

Figure 5.1 Glacial features of the study area

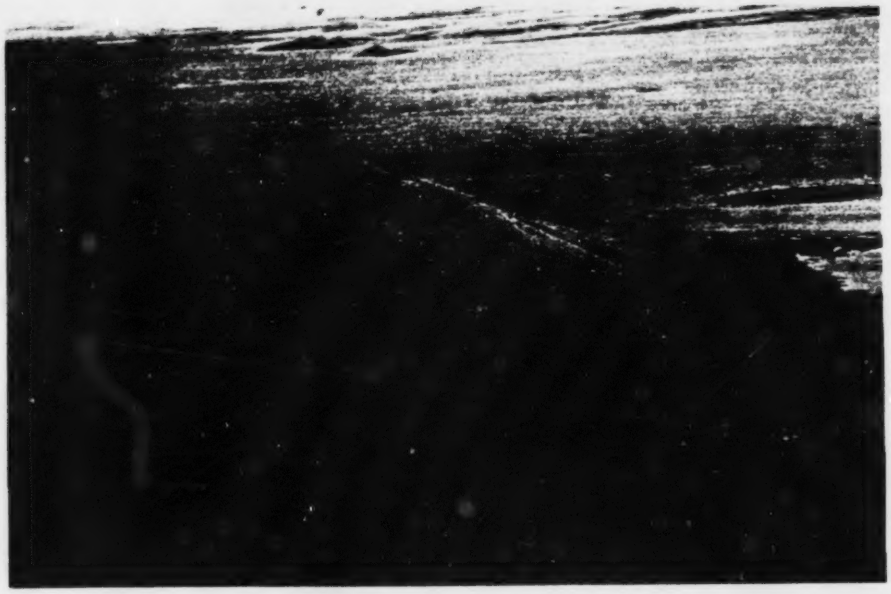


Figure 5.2 A kame on the shores of Bluenose Lake

Figure 5.3 Ancient driftwood along the shore of "Hornaday" Lake

from the southeast, but in the study area it was restricted to the coastal strip near Croker River (Fig. 5.1).

The land was depressed by the weight of glacial ice. Upon the final melting of glacial ice, marine incursion of the depressed areas occurred. This is evidenced by fragments of raised beaches, abandoned deltas, wave-washed surfaces and pockets of marine sediments at elevations up to 45 m ASL.

The surficial deposits indicate that the central part of Melville Hills may have escaped glaciation during the Pleistocene, or if glaciated, it occurred during an early glacial period. In either case, this area was a refuge for arctic biota when the rest of the region was covered by glacial ice. The "inactive ice area" may have been covered by ice that soon became stagnant during the main Wisconsinan ice advance which flowed around Melville Hills. An alternative explanation is that an early glacial event covered this area and the main Wisconsinan advance stalled at the Bluenose moraine. This possibility is supported by the great age of the fossil wood and the presence of wood resembling white pine, indicating the possibility of an interstadial age of the wood. The two coastal glacial ice incursions had postdated the main Wisconsinan movement, but their timing relative to one another is unclear.

The present understanding of the Quaternary geology of Canada indicates that all of Canada had been glaciated during the Quaternary, except western Yukon, a narrow corridor east of the mountains in Northwest Territories and a small area in southern Alberta (Fulton 1989). If indeed portions of the Melville Hills escaped glaciation, the implications on the natural history of the mainland would be enormous. Even if the area had been covered by an early glaciation, the implications for the biology of the mainland Arctic would be far-reaching, by providing a refugium during an era of widespread glaciation.

It must be noted that the extent of glaciation or non-glaciation could not be determined with certainty during a brief general reconnaissance survey. It is therefore important to conduct a thorough study of the Quaternary geology of the area, coupled with an equally thorough examination of biotic implications, in terms of plant and animal geography.

5.2 Surficial Materials

Glaciation and subsequent marine inundation influenced the distribution of surface materials. In the central areas the evidence of glaciation is questionable and the surface materials appear to be derived from local bedrock sources. Elsewhere, glaciers eroded the bedrock and unconsolidated sediments, and spread the debris across the landscape as till in a blanket of varying thickness. Glacial meltwaters, flowing either under the ice or on land, deposited extensive amounts of glaciofluvial sands and gravels. Evidence of glacial lakes was found north of Bluenose Lake (St-Onge and McMartin 1987) in the form of rhythmic (varved) clay and silt deposits. The only other sediments were deposited as small silt pockets during the marine invasion of coastal areas. Postglacial deposition of peat was limited by the severe climate to a few, thin deposits.

5.2.1 Old Glacial Till or Residual Soil Material

This material is found on the central part of the Melville Hills where there is no evidence of glacial landforms and may have been glaciated during an early Pleistocene glaciation, if ever. This material is identified with the genetic prefix 'r' on the accompanying map (in pocket). The composition of the soil material reflects the composition of the underlying bedrock. The minerology of the soil material derived from quartzite bedrock is completely different from that derived from dolomite.

The parent material derived from quartzite (Sites #24 and 39) contains 2-3% calcite, but no dolomite. The texture varies from silty clay loam to loam, with abundant stones of local provenance.

The parent material derived from Proterozoic dolomite Sites #25, 33, 35 and 38) contains 12 to 29% dolomite and 4 to 10% calcite. The texture ranges from loam to clay loam, and stones are locally abundant.

5.2.2 Glacial Till

Till has been laid down by glaciers advancing generally from the southeast or from the Amundsen Gulf. The composition of this till is also influenced by its provenance. In general, the till from the "inactive ice area" (between the Bluenose Lake and Melville Hills, Sites #3, 6, 8, and 18) has moderate amounts of dolomite (14 to 23%) and low amounts of calcite (4 to 9%). This till, including local rock rubble, is identified on the accompanying map with a genetic prefix 't'. The till from the actively moving ice areas (Sites #11, 20 and 37) has very high proportions of dolomite (31 to 46%), but low amounts of calcite (3 to 8%). This till is mapped with a genetic prefix 'm' on the accompanying map.

The texture of the fine skeleton varies from sandy loam to silty clay, but it is mostly in the clay loam class, with about equal proportions of sand, silt and clay. The stone content is variable, becoming very stony if the till is thin over bedrock. Most stones are of local provenance, but crystalline stones are also common.

The thickness of the till is extremely variable. It is probably tens of metres thick in moraines, but it can be only a thin veneer over bedrock on some ridges, or it may be entirely lacking. The bedrock is usually frost-shattered and rubbly.

5.2.3 Glaciofluvial Deposits

Glaciofluvial materials are found in eskers: narrow, sinuous gravelly ridges that often stretch for several kilometres, often flanked by outwash sand plains. Kames are gravelly, cone-shaped ice contact deposits. Glacial meltwater channels are marked by sand and gravel deposits that occur in broad channels, now occupied by underfit streams.

Glaciofluvial deposits are usually stratified, cross-bedded sand and gravel. The fine matrix is 95-100% sand. Mineralogically, they resemble the composition of the till from which it was derived: it is calcareous, with a high proportion of dolomite fragments.

Kames are particularly abundant in the area west of the Bluenose Lake morainic complex. Some of the kames are small (3 m high), but others may reach 30 m. Many kames are centered on a small, circular patch of silt or fine sand.

A series of deltas were noted in the Croker River area, where the glacial meltwaters entered a body of water at successively lower elevations. As some of the highest ones were graded to high elevations (about 375 m ASL), well above the known extent of marine incursion, they may relate to small, short-term proglacial lakes that were dammed by remnant glacial ice in Amundsen Gulf. Deltas at lower level undoubtedly represent deposits into the postglacial sea.

5.2.4 Marine Sediments

Only one marine deposit was sampled, near Pearce Point (Site #31). It contained about equal proportions of dolomite (14%) and calcite (13%) in its mineral composition. The relatively high content of calcite suggests transport from a distant calcite-rich source.

The marine sediments are in the heavy clay textural class, with about 66% clay, 33% silt and negligible amounts of sand. The deposit is usually free of stones.

5.2.5 Organic Deposits

Organic deposits occur in localized areas of poorly drained depressions. Most display a polygonal pattern, caused by ice wedge development (Fig. 5.4). The eventual erosion of the ice wedges can create isolated peat mounds, separated from the others by a deep trench. The thickness of peat seldom exceeds 1 m. The peat is usually moderately well decomposed and contains large amounts (35 to 50% by weight) of mineral soil particles. These mineral soil grains and even boulders can occur throughout the peat deposits, due to mixing by frost action.

The ages of different strata in a peat deposit on the east shore of "Hornaday Lake" have been determined as follows:

Depth	^{14}C age	Lab No.
5 - 10 cm	2200 ± 80 yrs	GSC-5200
30 - 34 cm	1750 ± 90 yrs	GSC-5194
115 - 117 cm	4030 ± 100 yrs	GSC-5188

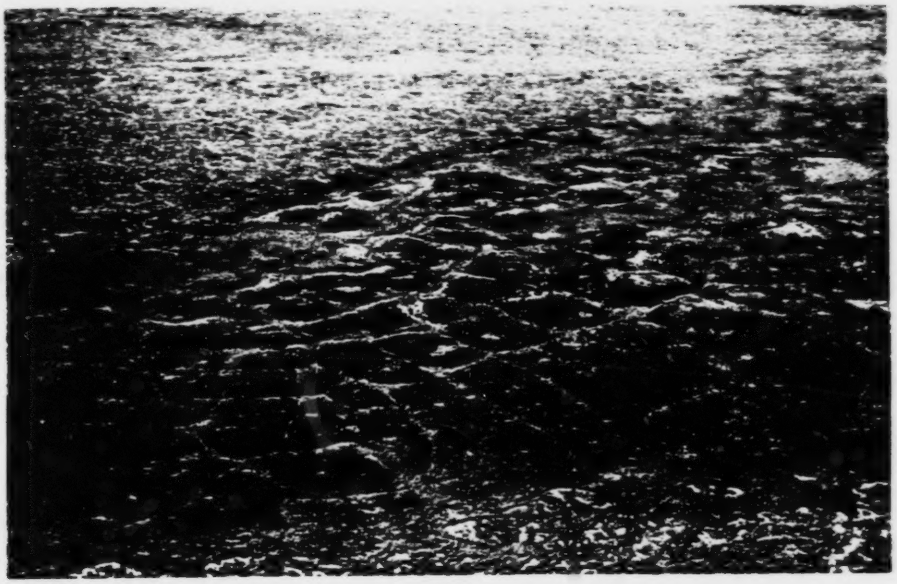


Figure 5.4 Eroding high center polygons

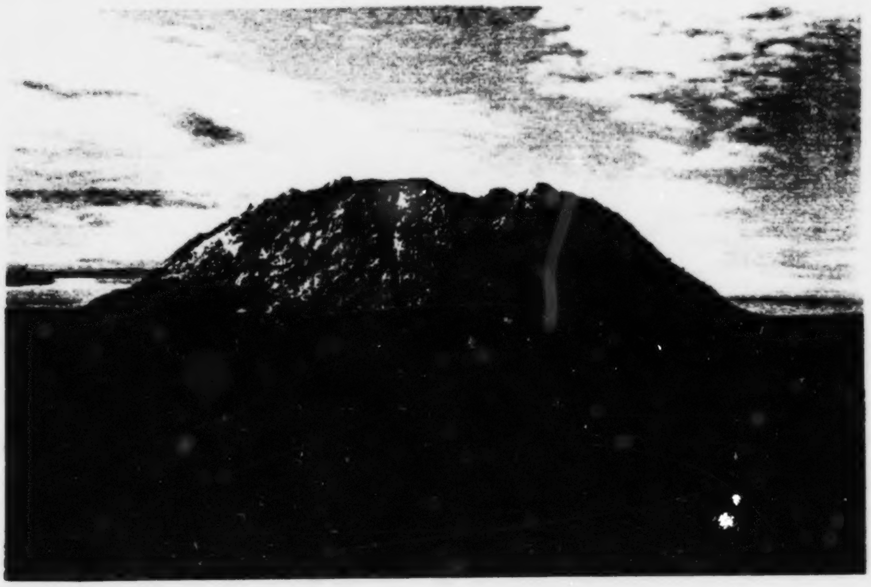


Figure 6.1 A 27-m high pingo

6. PERMAFROST AND PERIGLACIAL PHENOMENA

The relatively severe climate prevalent in the area creates conditions typical of polar regions. The ground remains below the freezing point of water through the year, as only a thin surface layer thaws every summer (the active layer). Frost action causes the churning of soil, sorting of stones and segregation of ground ice, often resulting in patterned ground.

6.1 Permafrost and Active Layer

Permafrost occurs under all land surfaces, even in bedrock. The ice content of the permafrost is variable: it may be highly icy under poorly drained conditions, or it may be free of ice as in bedrock. The thickness of the perennially frozen layer is not known, but it probably reaches several hundred metres.

The surface layer that thaws and re-freezes every year is the active layer. Its thickness varies according to the properties of the material; it is generally the thickest in bedrock, or in dry, coarse-grained soil (1 m). It is about 65 to 80 cm thick in well drained loamy soils. The active layer is the thinnest in poorly drained, peaty soils at about 40 cm.

6.2 Periglacial Phenomena

The presence of permafrost, the intense frost action and repeated freeze-thaw cycles cause the soil to crack and heave, and to develop segregated bodies of ground ice. These result in a variety of surface forms, collectively known as patterned terrain.

6.2.1 Pingos

Pingos are conical hills that have a core of ice. Pingos are formed when parts of a lake become drained and permafrost invades the formerly unfrozen lakebed. The water in the lake sediments is expelled into the unfrozen core, as permafrost advances from all sides. Eventually, the pressure becomes very great and is relieved by an upward expansion of the water and ground surface. As permafrost is established under the drained lakebed, the water turns to ice and further pushes the surface upward.

Several small pingos were noted in the study area. These are well rounded, indicating a smoothing of their surface by erosion. By contrast, a large, steep-sided, fresh-looking pingo was found on the southwestern boundary of the study area (Fig. 6.1), in a drained bay of a lake. Its height was estimated by altimeter readings to be about 27 m. The sides of the pingo are largely unvegetated, but there is a small, vegetated depression at its summit. The steepness of and lack of vegetation on the slopes indicate a recent origin of the pingo, but the vegetated summit suggests that it has existed for several decades, perhaps centuries. The location of this pingo is given on the accompanying large scale map.

6.2.2 Polygons

The extremely cold winter temperatures cause the ground to shrink and crack. When viewed from above, the cracks form a polygonal pattern. Moisture seeping into the cracks freezes, and eventually ice wedges are formed in the polygonal pattern initiated by the cracks. Polygons in the study area are found in light-textured surface deposits, in sand and gravel plains, and in wet lowlands.

Very large polygons are found on the highest parts of the morainic belt around the northern and eastern flanks of the Melville Hills and on parts of the sparsely vegetated central highlands: areas which were not covered by the late-Wisconsinan glaciation. The sides of these polygons are often hundreds of metres long, marked by a polygonal trough where vegetation is more abundant. Smaller polygons often developed inside the large polygons (Fig. 6.2), or other patterns occur superimposed on the surface of the centers of large polygons (Fig. 6.3). The very large size of these polygons is unusual. Polygons of similar dimensions have been encountered in parts of the High Arctic and in the unglaciated portions of Yukon Territory. It is possible that they were formed in the study area during the long, intensely cold glacial periods when these areas did not have a protective cover of glacial ice.

Smaller, "normal-sized" polygons are found in glaciofluvial sand and gravel deposits (Fig. 6.4). The sides of these polygons are 10-20 m long, and the trenches are often deepened by the partial thawing of the ice wedges.

The sides of polygons in wet depressions are also 10-20 m long. They may occur as low center polygons, where the polygon trench is well developed, but the centres have not yet filled in with peat. In later stages, the polygon centres are level, with wet polygon trenches (Fig. 6.5). Small streams often follow such polygon trenches, eroding and deepening them. Small pools may form at junctions of ice wedges where the ice has thawed, resulting in a "beaded" stream pattern (Fig. 6.5). In older peatlands the trenches are deeply eroded, and the centres are high and dry, exposed to further erosion by wind or oxidation (Fig. 5.4).

6.2.3 Sorted Patterns

Frequent freeze-thaw cycles cause the heaving of stones to the surface. In addition, the stones are moved outward from a central point. On slopes, gravity causes the alignment of the stones and frost-heaved soils in long stripes (Fig. 6.6). On level areas the patterns are circular, and on gentle slopes they are irregular in shape (nets).

6.2.4 Nonsorted Patterns

In sparsely stony soils sorting is not evident, but the heaving of the ground can cause corresponding non-sorted stripes, circles and nets. The ground heaving can produce single mudboils: irregular to roughly circular patches of bare soil. On somewhat finer-textured soil many frost heaved, but unsorted, circular to irregular shaped low mounds can occur. The individual mounds are separated by shallow trenches, marked by vegetation growth (Fig. 6.7).

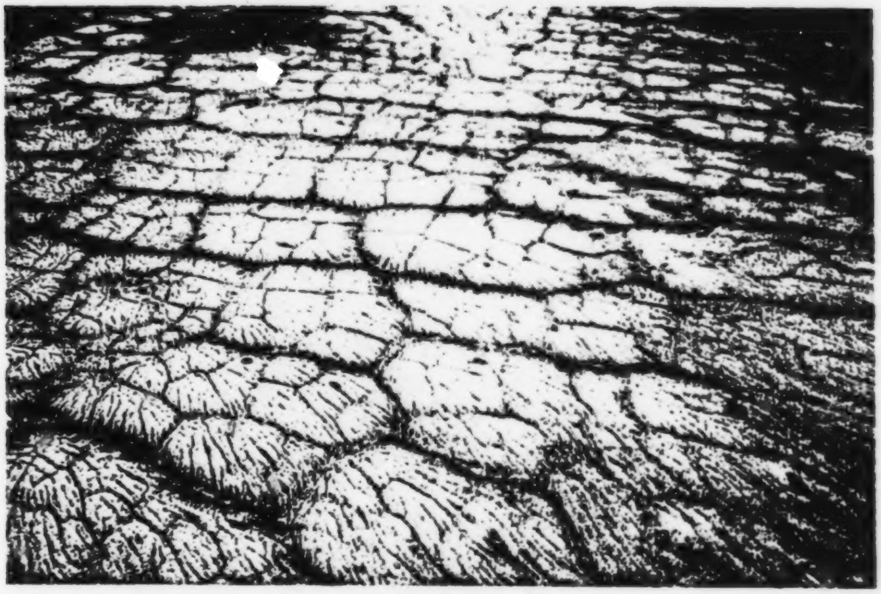


Figure 6.2 Large polygons with superimposed smaller polygons

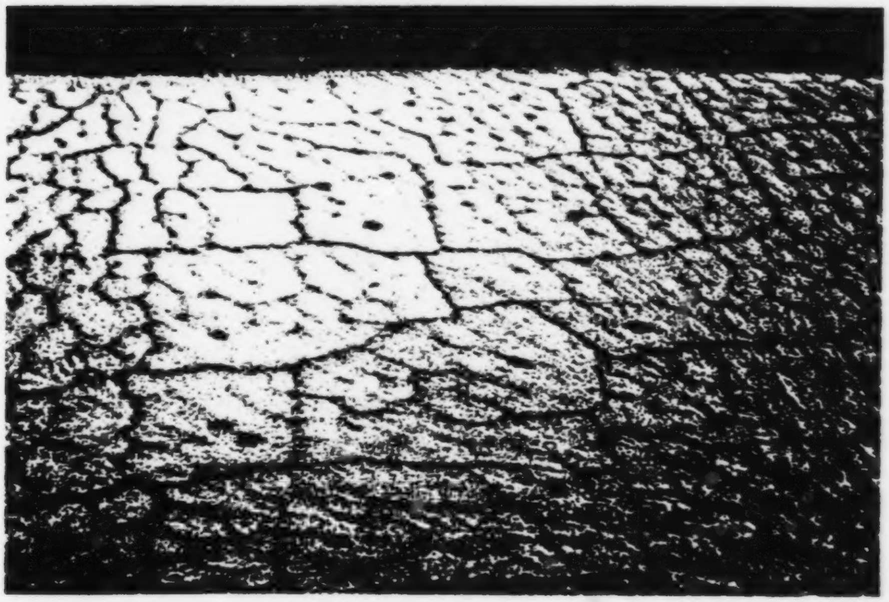


Figure 6.3 Large polygons with superimposed unsorted nets

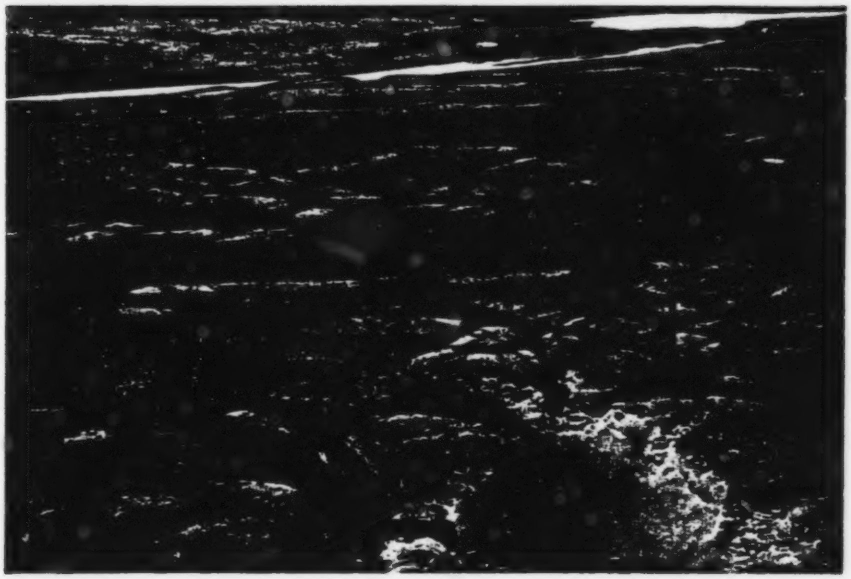


Figure 6.4 "Normal-sized" polygons in sand deposits

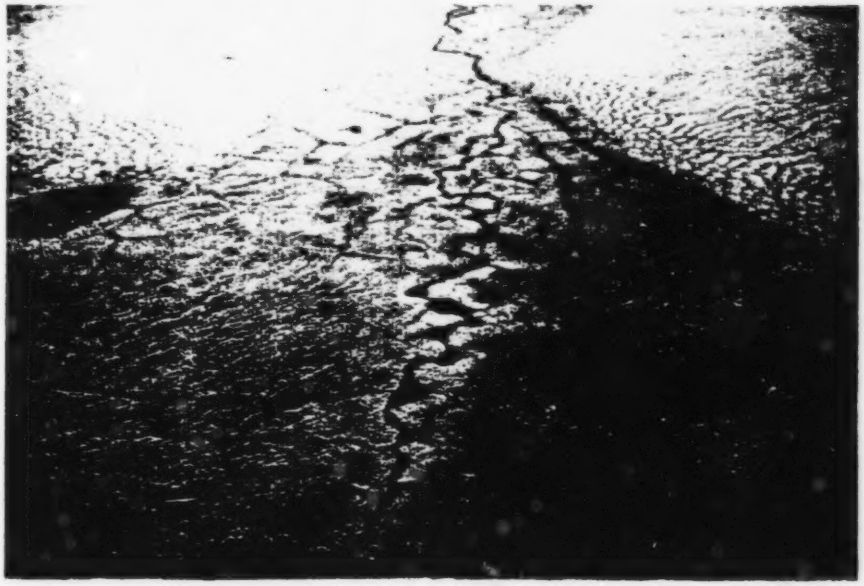


Figure 6.5 A "beaded" stream in a low-center polygon peatland

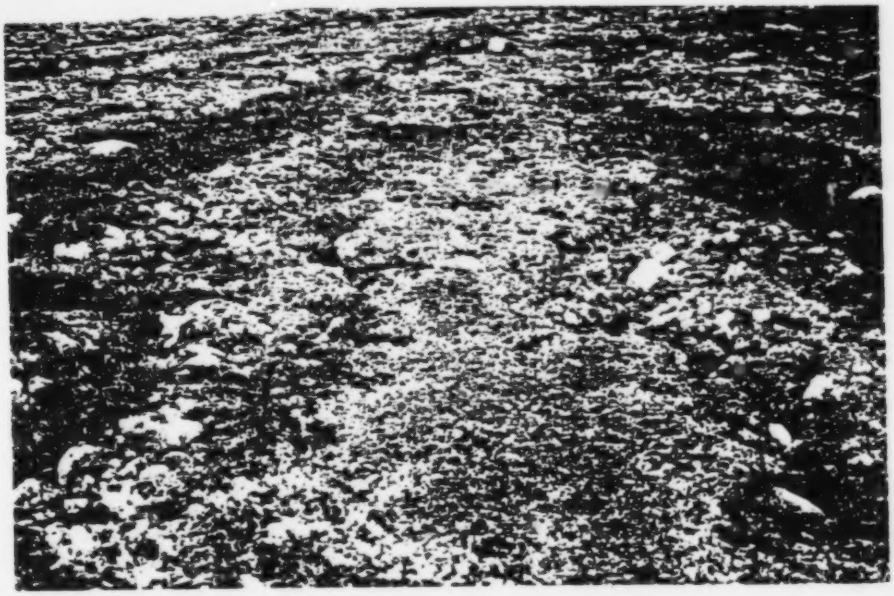


Figure 6.6 Sorted stripes on a slope

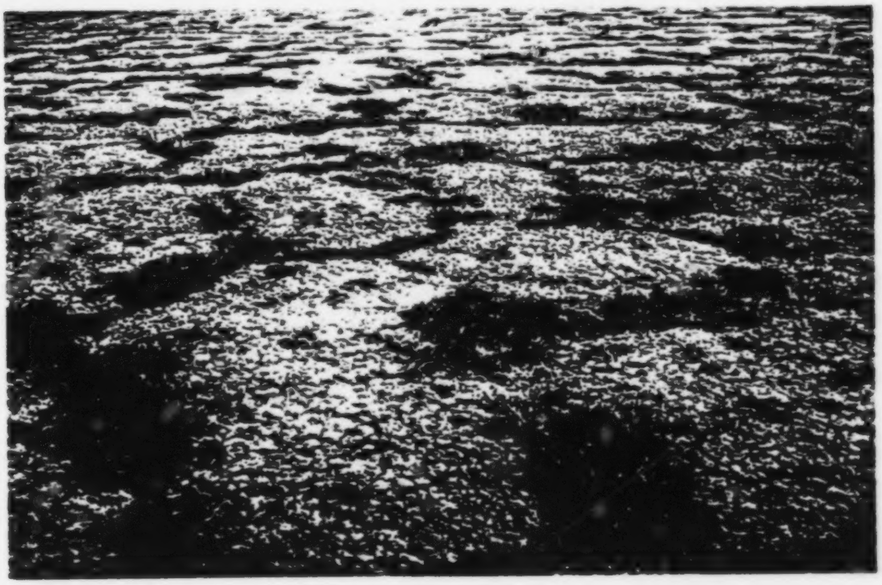


Figure 6.7 Nonsorted circles in fine-textured soil material

7. SOILS

Soil profile development is influenced by the parent material, drainage conditions, vegetation, periglacial action, and climate. In the study area, the parent materials were derived mainly from Proterozoic and Paleozoic dolomites and Proterozoic quartzites. Mixing of the parent materials by glacial transport resulted in a relatively uniform till, a dolomitic parent material having a loamy texture. On the non-glacial central portions of Melville Hills the parent material reflects the local bedrock, either quartzite or dolomite.

Soil classification is based on soil profile development, using the terminology of the Canadian Soil Survey Committee (1978). All soils in the study areas belong to the Cryosolic Order, as permafrost occurs within one metre of the surface everywhere. Most soils belong to the Turbic Cryosol Great Group, reflecting the intense frost churning prevalent in the area. Static Cryosols are found mainly on glaciofluvial parent materials.

The following account is based on an unpublished report by Tarnocai and Veldhuis (N.D.), which in turn was based on field work conducted in 1980, north of Lat. 68° (Fig. 7.1). This information was supplemented by observations and analyses made during the present survey. The broad soil landscapes have been mapped at a scale of 1:1,000,000 (Land Resource Research Centre 1986).

7.1 Hornaday Soil Association

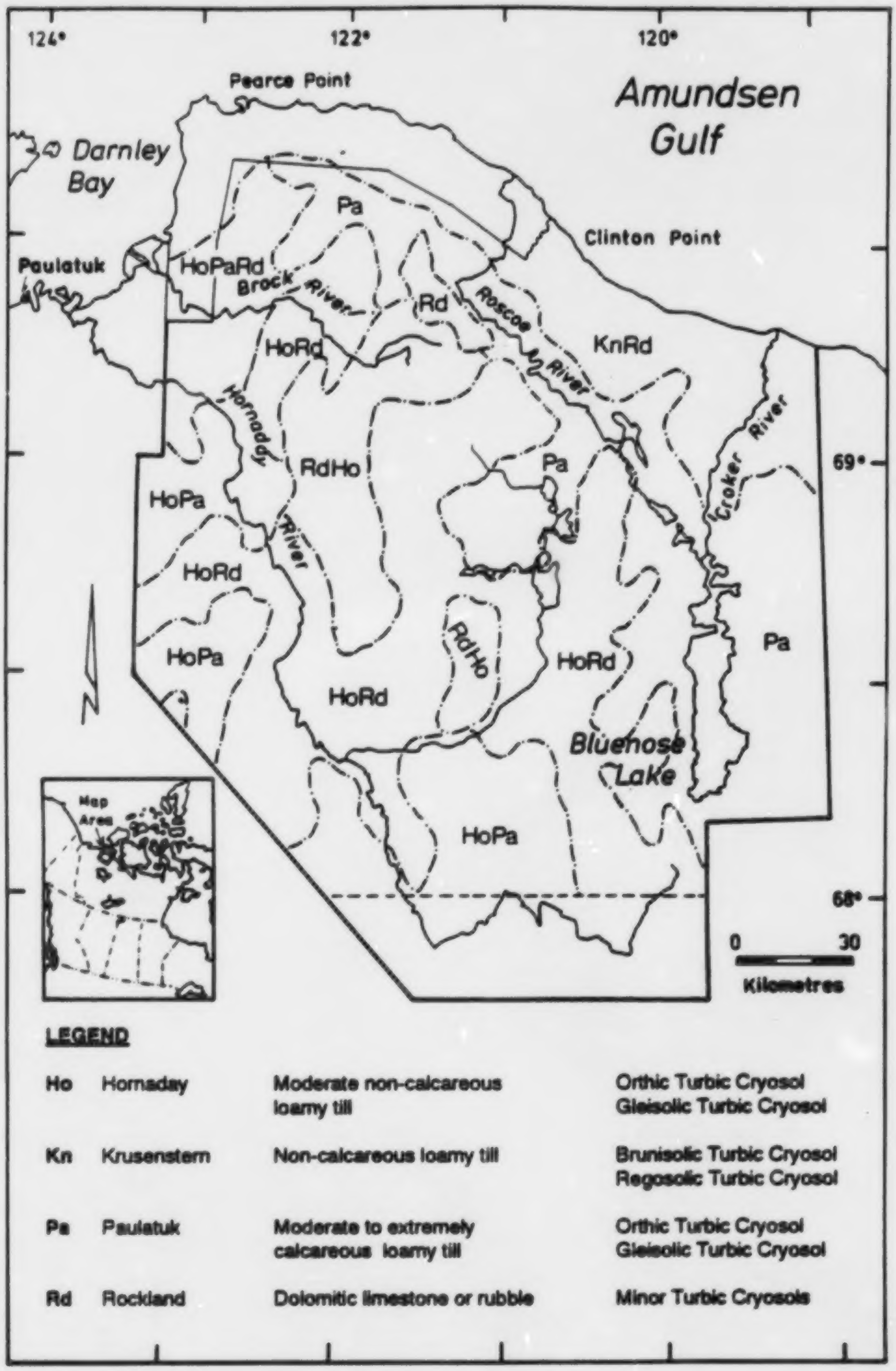
The Hornaday soils occur on weakly glaciated areas, and reflect the mineralogy of the underlying bedrock. It can vary from non-calcareous to moderately calcareous sandy loam to loam. Because of the widespread occurrence of patterned ground, these soils are strongly cryoturbated, as indicated by broken and displaced soil horizons. On well to imperfectly drained sites the most dominant soils by far are Orthic Turbic Cryosols, with well developed, but broken Bm horizons. Cryoturbated soils lacking a Bm or Bmy horizon (Regosolic Turbic Cryosols) do occur, but occupy only minor areas, while Gleysolic Turbic Cryosols are the dominant soil type on poorly drained sites. The latter soils also show a marked churning of the upper part of the profile, with large amounts of organic matter in the form of streaks and pockets that have been incorporated into the soil profile.

7.2 Kiktoreak Soil Association

The Kiktoreak soils developed on moderately decomposed (mesic) organic material, occurring in small areas of poorly drained depressions. The peat, composed of sedge or moss remains, has been subjected to cryoturbation, as shown by boulders that have been heaved to the surface near some ice wedge polygons. The common soil is Mesic Organic Cryosol. This soil association occurs in areas too small to be shown in Fig. 7.1.

7.3 Krusenstern Soil Association

The Krusenstern soils developed on moderately to highly calcareous loamy till parent materials. The soil units are usually strongly cryoturbated, as indicated by broken or displaced soil horizons. Brunisolic and Orthic Turbic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Hornaday River
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LEGEND
Ho Hornaday Moderate non-calcareous loamy till Orthic Turbic Cryosol Gleisolic Turbic Cryosol
Kn Krusenstern Non-calcareous loamy till Brunisolic Turbic Cryosol Regosolic Turbic Cryosol
Pa Paulatuk Moderate to extremely calcareous loamy till Orthic Turbic Cryosol Gleisolic Turbic Cryosol
Rd Rockland Dolomitic limestone or rubble Minor Turbic Cryosols

Figure 7.1 Soil landscapes of the study area (Land Resource Research Centre 1986)

Cryosols are the dominant soils on well to imperfectly drained sites. Regosolic Turbic Cryosols are present in areas affected by extreme cryoturbation that permits only weak horizon development. Gleisolic Turbic Cryosols are found in areas of impeded drainage.

7.4 Paulatuk Soil Association

The Paulatuk soils developed on moderately to extremely calcareous loamy till parent material. The soils are subject to intense cryoturbation, as evidenced by broken or displaced soil horizons. On the well to imperfectly drained sites Orthic Turbic Cryosols are the dominant soils. In poorly drained sites Gleisolic Turbic Cryosols are formed.

7.5 Tibjak Soil Association

The Tibjak soils developed on glaciofluvial materials, composed of moderately calcareous sand and gravel parent material. The soil units are cryoturbated only adjacent to ice wedge polygons, and most of the soils are stable. On such soils Brunisolic and Orthic Static Cryosols are dominant on well to imperfectly drained sites. On poorly drained sites Gleysolic Static Cryosols are the most dominant soils. Locally, some Eluviated Dystric Brunisols may be present, especially on south-facing slopes where the permafrost table is below the control section (1 m+).

7.6 Rockland

This surface material was considered to be a non-soil and was not described by Tarnocai and Veldhuis (N.D.). The material is exposed bedrock, or rock rubble.

8. PHYSIOGRAPHY

The study area is part of the Horton Plains, forming a part of the Interior Plains Region (Bostock 1970). The central feature is the Melville Hills, an area of uplands that lies generally above the 600 m contour. The highest part of the Melville Hills occurs in its northern portion at 877 m. The northern half of the study area has been further subdivided by Yorath _et al_. (1968) into the Darnley Bay Coastlands, the Melville Hills Morainic Belt, the Horton Plateau and the Hornaday Plateau. These physiographic units have been extended to cover the entire study area (Fig. 8.1).

8.1 Amundsen Coastlands

The Amundsen Coastlands (Darnley Bay Coastlands of Yorath _et al_. 1968) comprise a coastal strip of generally thin till over bedrock (Fig. 8.2), marked by fluting that is very strongly developed adjacent to Darnley Bay and near Croker River. The local relief is usually less than 100 m in the coastal areas, but may be as much as 150 m in the south.

8.2 Melville Hills Morainic Belt

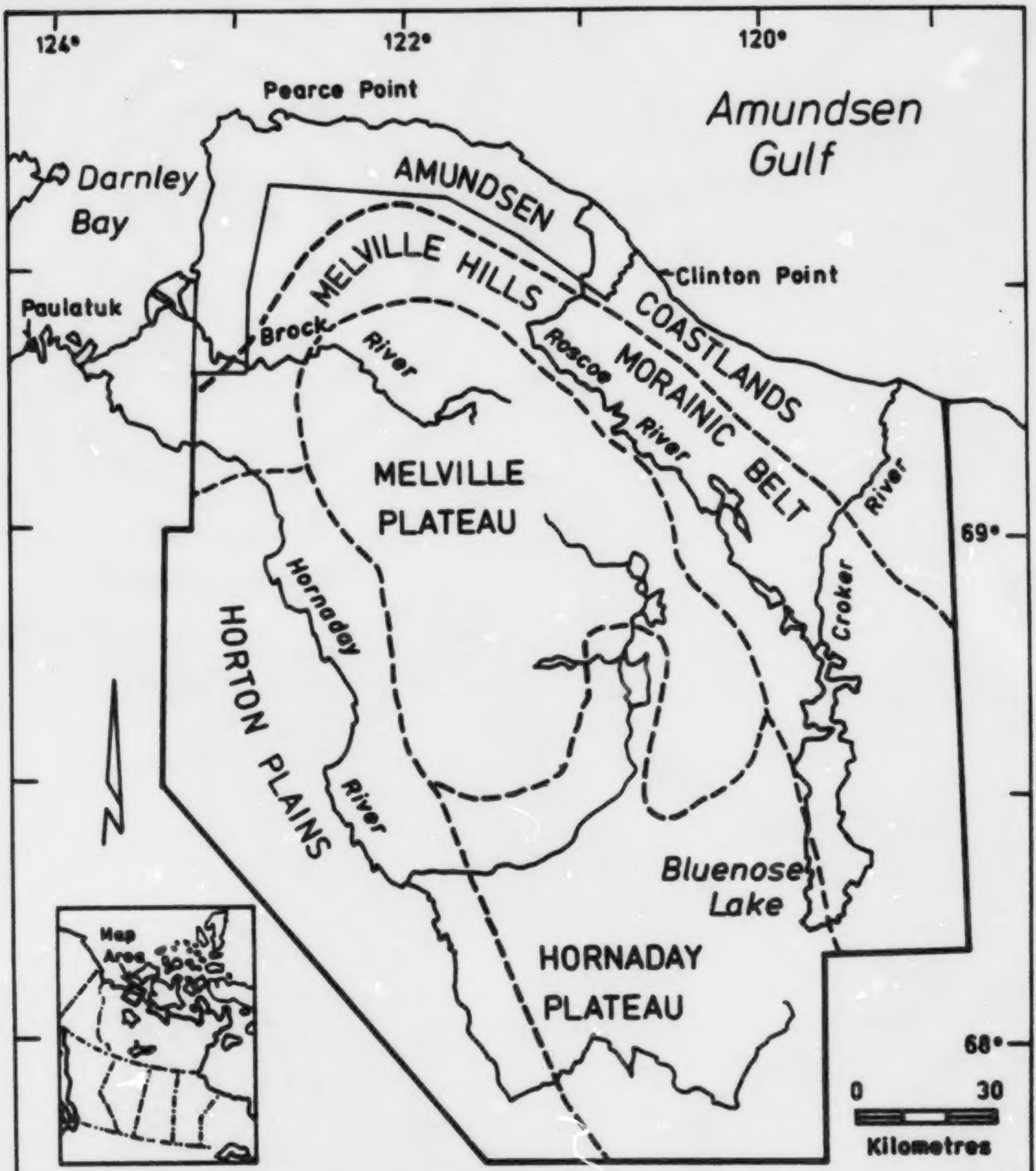
This area comprises a distinctive zone of roughly parallel morainic ridges and kames varying in elevation from 170 to 700 m ASL. In the east it includes the Bluenose Lake Moraine Complex of St-Onge and McMartin (1987). This morainic system of thick till and associated ice-contact glaciofluvial deposits marks the limit of active ice advance from the east and north. The landward limit of this moraine is marked by a large meltwater channel system that includes the upper reaches of Brock and Roscoe rivers. This system was formed by glaciofluvial erosion and deposition by meltwaters from the moraine that drained towards the west.

8.3 Melville Plateau

This area consists of tablelands lying generally above the 600-m contour. The individual tablelands are separated from one another by broad valleys. Precambrian dolomitic and silicious sandstone bedrock rubble mantles the tablelands and patches of deeper soil materials occur within the valleys. The paucity of erratics and mantle of bedrock rubble suggests that the Melville Plateau was largely ice-free during the last glaciation.

8.4 Hornaday Plateau

The Hornaday Plateau consists of tablelands of flat-bedded Paleozoic carbonate bedrock. The southern part of the area lies generally above the 600-m contour, and its surface is composed mainly of exposed bedrock or rock rubble. The northern part is characterized by deposits of inactive ice, such as ground morainic till and kames. Here the surface is gently rolling, with a few higher bedrock hills and diabase sills.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Amundsen Gulf
Darnley Bay
AMUNDSEN COASTLANDS
MELVILLE HILLS
MORAINIC BELT
Clinton Point
Paulatuk
Brock River
Roscoe River
MELVILLE PLATEAU
Hornaday River
HORTON PLAINS
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Bluenose Lake
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Kilometres
Map Area

Figure 8.1 Physiographic units of the study area

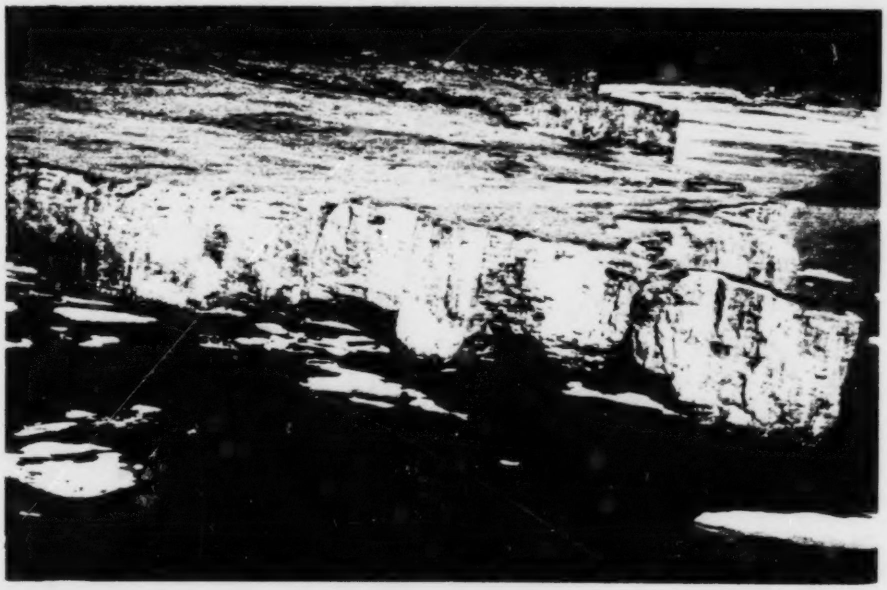


Figure 8.2 Coastal cliffs along Amundsen Gulf

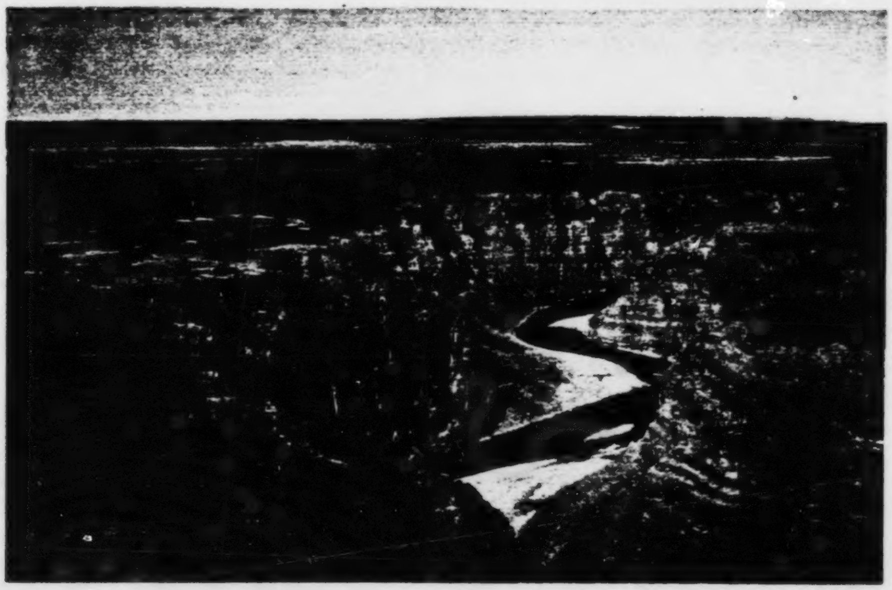


Figure 8.3 Part of the Hornaday River canyon

8.5 Horton Plains

The Horton Plain can be recognized by nearly flat-lying Paleozoic carbonate bedrock that is locally fluted and thinly mantled by glacial drift. Elevations rise gradually towards the south, reaching an elevation of about 600 m ASL. A canyon, located in the lower reaches of the Hornaday River, provides spectacular scenery (Fig. 8.3).

9. VEGETATION

The vegetation of the study area contains elements of polar semi-deserts and arctic tundra. The area lies at the boundary of floristically different regions: it includes the easternmost extent of occurrence of Beringian species and species of the central mainland Arctic region. The floristic variability is further increased by the presence of a large area that escaped glaciation during the Wisconsinan period; and indeed, portions may not have been glaciated during the Pleistocene period at all. This area would have served as a refugium where certain plants could survive the glacial periods.

9.1 Floristics

The floristics of the Melville Hills region are little known, based on distribution maps for vascular plants (Porsild and Cody 1980) and lichens (Thomson 1984). For that reason a large collection of bryophytes, lichens, and vascular plants was made during the field inventory. The results of that collection are indicated below.

9.1.1 Bryophytes

The bryophyte flora of this area is virtually unknown, as the nearest previous records were from Coppermine (Steere 1977; Robinson et al. 1989a, 1989b) and Bathurst Inlet (Steere and Scotter 1986) to the east; Great Bear Lake (Steere 1977) to the south; and Cape Parry (Steere and Scotter 1986), Horton River (Robinson et al. 1989a, 1989b), Horton-Anderson Rivers (Zoltai et al. 1979), and Reindeer Station (Holmen and Scotter 1971) to the west.

Appendix 1 lists 11 species of Hepaticae and 92 species of Musci from the Melville Hills region. The diversity of bryophytes is smaller than in surrounding areas. Steere and Scotter (1986) reported 19 species of Hepaticae and 155 species of Musci from the Cape Parry region. Holmen and Scotter (1971) reported 179 Musci from the Reindeer Preserve, Steere (1977) listed 61 species of Hepaticae and 204 of Musci from the Great Bear Lake and Coppermine regions, and Steere and Scotter (1979) recorded 13 species of Hepaticae and 184 taxa of Musci from Banks Island. More intensive collection over a longer interval may increase the number of bryophytes for the Melville Hills region.

Although the collection was smaller than in adjacent areas, there were a number of interesting species within it. Some of the more interesting records include the following:

Bryum wrightii: The second report of this moss from the continental Northwest Territories. Along with Brassard's (1972) record from 127 degrees west longitude, this is one of the few records of this species from continental Northwest Territories.

Campylium arcticum: This species is known from Alaska and the Canadian Arctic. The Melville Hills locality is one of the few Canadian reports from the western Canadian mainland.

Cinclidium arcticum: An arctic species known as far south as southern Baffin Island in the east, and Churchill and the Great Bear Lake-Mackenzie Mountain area in the west. Farther north, it is known from northern Alaska, Banks Island and the Canadian Arctic Islands and Greenland (Steere 1978).

Cinclidium latifolium: A rare arctic species known, in North America, from northern Alaska, Banks Island, the Churchill Area (Manitoba), Ellesmere Island, Greenland, and on two of the eastern Canadian Arctic Islands. This is the first report of the species from the Mackenzie District (Steere 1978).

Desmatodon leucostoma: An arctic-alpine species known in North America from Alaska, the Yukon, the Northwest Territories and Greenland, extending southward through the Rocky Mountains of Alberta to Colorado.

Drepanocladus lycopodioides var. brevifolius: An arctic species occurring from northern Greenland, Ellesmere Island and northern Alaska south to this locality in the west and Ungava in the east; also known from the Horton River area (Schofield 1972).

Grimmia plagiopodia: A species not recently mapped, but according to Ireland et al. (1987), new to continental Northwest Territories. Otherwise in Canada known from Alberta, British Columbia, Saskatchewan and Ontario.

Hypnum procerrimum: Known in North America from scattered localities along the western cordillera south to the U.S. border, northern Alaska, one site near the Horton River, several of the Canadian Arctic Islands, and Newfoundland (Schofield 1980).

Schistidium andreaeopsis: Ochyra and Afonina (1986) placed that name into synonymy with holmenianum originally described from Sibirian material. In North America, they mapped its occurrence from Greenland and the Canadian Arctic Islands west to the north slope of Alaska. They report the only localities from the continental Northwest Territories, west of Hudson Bay from the Boothia Peninsula and from the Cape Parry region at 124 degrees west longitude. This is the second report from continental Northwest Territories west of the Boothia.

Schistidium tenerum: Elsewhere known from Greenland, scattered in the western cordillera, north coast of Alaska, Great Bear Lake, and Great Slave Lake (Schofield 1972).

Tetraplodon pallidus: Known from arctic Alaska, the Yukon Territory, and five localities in the Mackenzie District, Northwest Territories, as well as from northern Greenland and the northeastern Arctic Archipelago (Steere 1978). The present locality is the most northeasterly in western North America.

Tetraplodon paradoxus: A species of arctic Alaska, known eastward only from the Great Bear Lake area, the Mackenzie Delta area, and one site on Baffin Island (Brassard et al. 1982).

Timmia norvegica: This is a widespread arctic species with several disjunct stations in the western cordillera and in Labrador-Newfoundland. This is the first record of the species from the northern coast of continental Northwest

Territories, although collections are known from the Yukon, Great Slave Lake, and Banks Island (Brassard 1979).

Timmia sibirica: Previously known from northern Alaska, the Yukon Territory, the Mackenzie Mountains in the Northwest Territories, northern British Columbia, and Alberta in the west, and from Greenland, west to Somerset and Axel Heiberg islands. The present station joins the previously known eastern and western portions of the North American distribution (Horton 1981).

Voitia hyperborea: One of the southernmost stations for this arctic species, otherwise known from northern Alaska, the Canadian Arctic Islands, the Horton River, and the Mackenzie Mountains at 65 degrees north latitude (Steere 1978).

9.1.2 Lichens

The lichen flora of the Melville Hills region is fairly rich. Included within the collection were 158 species of lichens and one lichen fungus parasite (Appendix 2). The nearest lichen reports are those to the west at the Reindeer Preserve (Ahti et al. 1973), and to the east at Coppermine (Thomson 1970) and in the Bathurst Inlet region (Thomson and Scotter 1983). More than 350 taxa were reported from the Reindeer Preserve, 196 taxa from the vicinity of Coppermine, and 223 taxa from the Bathurst Inlet region.

Among the interesting lichens from the Melville Hills regions were the following:

Aspicilia supertegens: This record fills a gap between Ellesmere Island and Alaska.

Bacidia siberiensis: This specimen on bark extends the range of this amphi-Beringian species eastward from Lawrence Island in the Bering Sea.

Cladonia pseudorangiformis: This is a northern record for this species.

Collema limosum: A rare species seldom collected in the American Arctic, the nearest station is at Anderson River to the west.

Polysporina urceolata: This collection is a range extension for this arctic alpine species which was known from British Columbia and Bathurst Island in the Northwest Territories.

9.1.3 Vascular Plants

Because of the historical difficulty of access to the Melville Hills region, very few vascular plant collections have been made previously. The only previous known collections from the Melville Hills region were by J.A. Parmelee, Agriculture Canada, at Clinton Point in 1963 and by Beth Tiaping, York University, and various students from the University of British Columbia at the Pearce Point area. None of those records has been published. This study for the Canadian Parks Service recorded 236 taxa of vascular plants in the area (Appendix 3).

Many of the collections reported help complete the known distribution of taxa which were certainly to be expected there, based on Porsild and Cody (1980). A number of taxa are, however, of particular interest. Among these are:

Festuca vivipara ssp. *glabra*: Widely disjunct from nearest known sites.

Puccinellia angustata: New to the District of Mackenzie.

Juncus arcticus: A considerable extension of the known range westward from Bathurst Inlet.

Salix hastata: The most easterly site yet reported.

Salix phlebophylla: The most easterly mainland site yet reported.

Cerastium regelii: New to the District of Mackenzie.

Papaver cornwallisensis: Not previously reported from the District of Mackenzie.

Papaver macounii: An extension of the known range eastward from the Richardson Mountains.

Draba incerta: A northern Cordillearan species disjunct from the central Mackenzie Mountains.

Draba subcapitata: Here reported for the first time from the Continental Northwest Territories.

Potentilla biflora: An Amphi-Beringian species near its eastern North American limit of range.

Oxytropis arctobia: A North American Arctic Archipelago endemic which barely enters the Continental Northwest Territories.

Gentiana prostrata: A considerable range extension eastward from the Richardson Mountains of an Amphi-Beringian species.

Gentiana detonsa ssp. *detonsa*: A circumpolar species which has many large gaps in its distribution.

Phlox richardsonii: An endemic of northwestern North America which is at its easternmost known sites in the District of Mackenzie.

Mertensia drummondii: A northwestern North American endemic.

Castilleja hyperborea: An Amphi-Beringian species at its easternmost known limit of distribution.

Pedicularis flammea: An Amphi-Atlantic species at its known northwestern limit of distribution.

Plantago maritima ssp. juncoides: An Amphi-Atlantic plant at its known northwestern limit of distribution.

Crepis nana: An Amphi-Beringian species at its known northeastern limit of distribution in the District of Mackenzie.

Among the vascular plants collected were Phlox richardsonii and Mertensia drummondii, which are endemic to the northwestern part of the Northwest Territories and Northern Alaska. Their presence in this area would lend support to the possibility of parts of the area being unglaciated.

The number of vascular plants in the area is similar to the Cape Parry/Horton River region where 237 taxa of vascular plants were collected (Zoltai et al. 1979) and the 260 taxa of vascular plant from the Bathurst Inlet region (Zoltai et al. 1980; Cody et al. 1984).

9.2 Broad Vegetation Types

Differences in vegetation within the study area can be related to the parent soil material (texture, mineralogy) and the moisture regime of the different sites. Further differences are caused by local landform: exposure or protection from the elements. The resulting communities are far too numerous to be adequately studied during a brief reconnaissance survey. However, it was found that broad vegetation types were often consistently associated with specific terrain types that could be readily recognized in the field.

During the brief reconnaissance survey, broad vegetation types were identified and these were later used to map the vegetation of the study area at a scale of 1:250,000 (in pocket). The scale of mapping and the scant field control dictated that the vegetation types be broad, recognizable on small scale air photos, and mappable at the given scale. The resulting vegetation types are based on the physiognomy of the floral assemblages, rather than on floristics. This gave a workable tool for an initial indication of vegetation distribution in the study area, especially when combined with the estimated ground cover of the vegetation.

No vegetation studies have been previously conducted in the study area. The vegetation of the area immediately to the west (Horton-Anderson area, Zoltai et al. 1979) has been described. This report was consulted to help to characterize the broad vegetation types.

9.2.1 Rock - Lichen (I on attached map)

This type of vegetation occurs on bedrock outcrops and on excessively bouldery terrain. It in composed mainly of saxicolous lichens, but umbilicate lichens often covers some rock surfaces.

9.2.2 Dwarf Shrubs - Herbs - Sedge (II on attached map)

This vegetation type is widespread on calcareous soils. It is dominated by Dryas integrifolia growing in low, ground-hugging clumps. The other characteristic component is Kobresia myosuroides, growing in dense tufts. Other dwarf shrubs (*Salix arctica*) may be present, especially in wetter areas. The ground cover is variable, depending on stoniness (Fig. 9.1), drainage (Fig. 9.2), or patterned terrain (Fig. 9.3). Legumes, such as *Hedysarum alpinum*, *Oxytropis maydelliana*, *Astragalus alpinus* are often present. Showy flowers of *Lupinus alpinus* (Fig. 9.4) may be found on some protected slopes.

9.2.3 Cottongrass - Willow (III on attached map)

This vegetation type occurs on parent materials derived from quartzite bedrock and is only weakly calcareous. In the moister areas *Eriophorum scheuchzeri* dominates (Fig. 9.5), with some *Sphagnum teres* and *S. russowii*. In the better drained areas cottongrass and prostrate *Salix arctica* are the main species (Fig. 9.6).

9.2.4 Herbs - Nudum (IV on attached map)

This vegetation type is common on excessively drained sandy and gravelly soils. It is characterized by widely scattered plants of *Potentilla nivea*, *P. vahliana*, *Astragalus alpinus*, *Hedysarum alpinum*. Ground-hugging woody plants, such as *Dryas integrifolia* are also found.

9.2.5 High Shrubs (V on attached map)

This vegetation type can be found in closed stands on south facing slopes and on alluvial sites in the southeastern part of the study area (Fig. 9.7). The willows are *Salix lanata*, *S. alaxensis*, and *S. planifolia*. Various herbs and grasses form the ground vegetation on the slopes, and *Equisetum pratense* occurs on the alluvial sites.

9.2.6 Sedge Meadows (VI on attached maps)

This vegetation type is common on wet sites, whether in depressions or on slopes watered by perennial snowbanks (Fig. 9.8). The dominant species is *Carex aquatilis*, *S. saxatilis*, and *C. membranacea*. Other species usually present are *Saxifraga hirculus*, *Polygonum viviparum* and *Pedicularis sudetica*.

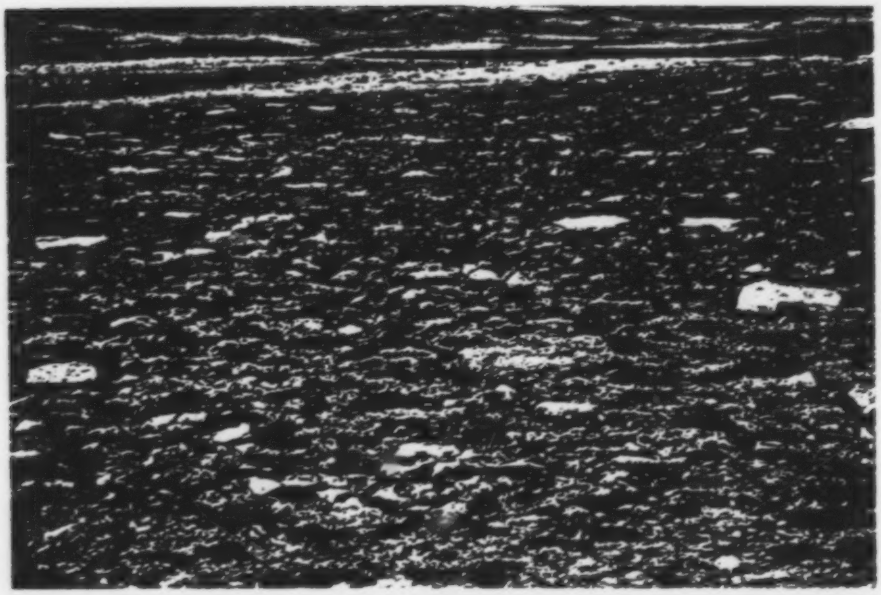


Figure 9.1 Sparse Dryas cover on stony soil

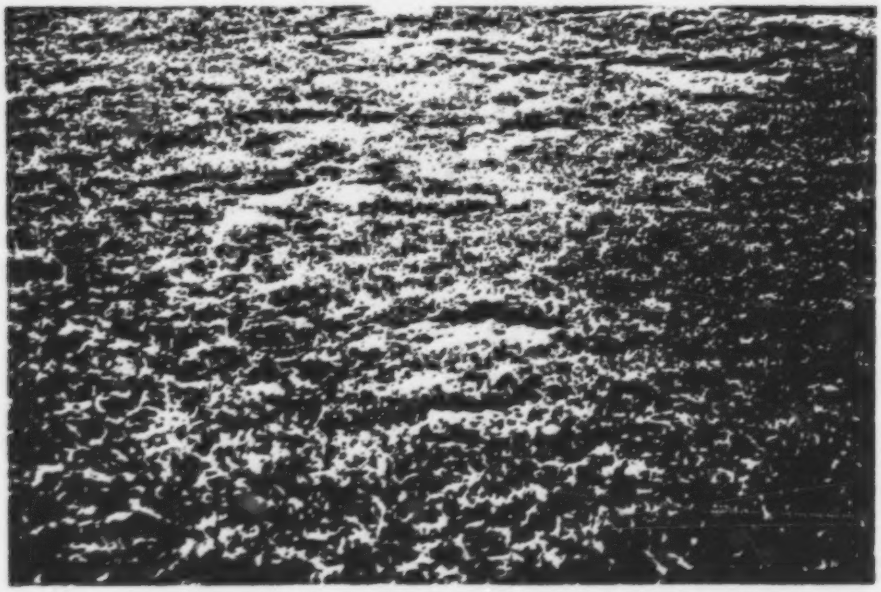


Figure 9.2 Nearly complete cover of Dryas - Kobresia on a moist slope

Figure 9.3 Patchy Dryas - Kobresia cover between nonsorted stripes

Figure 9.4 Lupinus alpinus in blossom

Figure 9.5 A meadow dominated by cottongrass

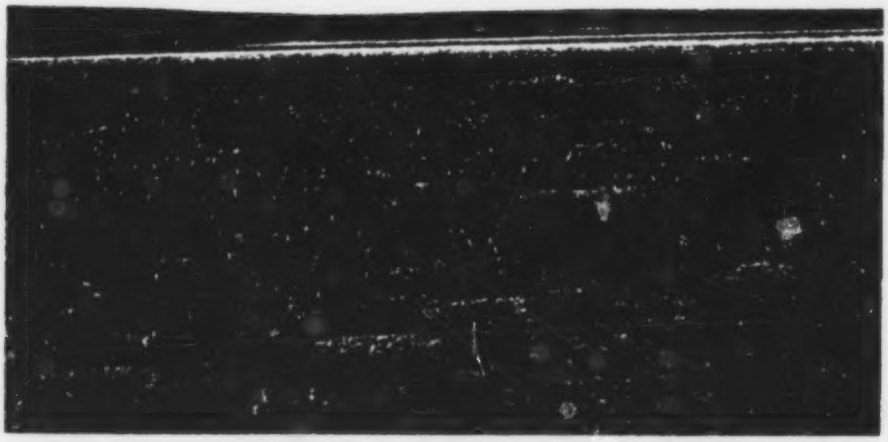


Figure 9.6 Nearly complete cover of cottongrass and arctic willow

Figure 9.7 Tall willow shrubs along the Hornaday River

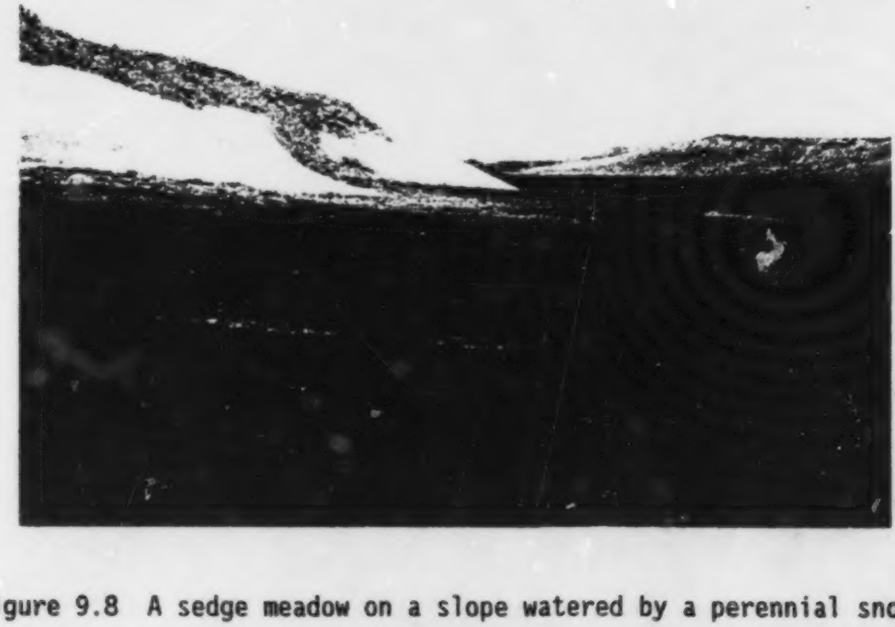


Figure 9.8 A sedge meadow on a slope watered by a perennial snowbank

10. ECOLOGICAL LAND CLASSIFICATION

Ecological (bio-physical) land classification of the study area was completed, using the principles outlined by Lacate (1969). The terminology of this approach has been revised by the Canada Committee on Ecological Land Classification. This new terminology will be used throughout, with the equivalents of the original terminology also indicated.

Ecological land classification is an evaluation of several elements of the physical environment in terms of their importance to the biological components. Thus the various physical components, such as climate, soil texture, soil mineralogy, internal drainage, and slope are evaluated with regard to their influence on plant growth and distribution, and indirectly, on animal populations. During this process, groups of physical factors that have similar influence on the living environment are grouped into classes. During the mapping process, areas that are alike are delineated.

In this classification the ecoclimatic regions (land regions) are the broadest subdivisions, based mainly on the effect of climate on the biosphere. The next level is the ecodistrict (land district) occurring within each ecoclimatic region, where the physiography and soil materials that influence vegetation growth and distribution are used as distinguishing criteria. At the next lower level, the mapping level at 1:250,000 scale, ecosections (land systems) are recognized on the basis of differences in the soil and landform that affect the biological components. For convenience, the ecosections are also used to indicate the broad vegetation types that occur on them.

10.1 Ecoclimatic Regions and Ecodistricts

The map of Ecoclimatic Regions of Canada (Ecoregions Working Group 1989) shows that the entire study area lies within the Low Arctic Ecoclimatic Region. However, the central portion of the area, lying approximately above the 650 m (2000 ft) contour, resembles the Mid-Arctic Ecoclimatic Region in its vegetation and ground cover. It can be considered as an outlier of the Mid-Arctic Ecoclimatic region. The ecodistricts are shown in Fig. 10.1.

10.1.1 Mid-Arctic Ecoclimatic Region

The normal sites of this region are characterized by a 40-60% vegetation cover, the rest being bare ground. Summers are short and cool, while the winters are long and extremely cold (Ecoregions W.G. 1989). There is one ecodistrict in this region:

The Central Plateau Ecodistrict is a gently undulating area, with well integrated surface drainage and no lakes. The dominant soil material is a highly calcareous loam to sandy loam, but some areas are only slightly calcareous. Frost-shattered bedrock outcrops form felsenmeer in some areas.

10.1.2 Low Arctic Ecoclimatic Region

In the Low Arctic Ecoclimatic Region the ground has a nearly continuous cover of vegetation of herbs, graminoids and low shrubs, but up to 30%

bare ground may be present in some areas. Summers are cool, lasting about four months, and the winters are long and extremely cold. There are five ecodistricts in this region (Fig. 10.1):

The Coastal Plain Ecodistrict is a gently rolling plain, where the topography is controlled largely by highly calcareous glacial drift in ground moraines or in drumlinoid lineations. Wave-washed bedrock, raised marine beaches and deltas, or local marine silt pockets may be found in a narrow strip along the coastline, generally below 160 m (600 ft) ASM.

The Drumlinized Plain Ecodistrict is characterized by long but narrow drumlin hills, often separated by narrow lakes or streams. The material is highly calcareous loam, and the vegetation cover is nearly 100% complete.

The Morainic Belt Ecodistrict consists of moderately to strongly rolling terrain of morainic hills composed of thick loamy to loamy sand till that is highly calcareous. Extensive fluvial deposits occur in glacial spillways. Lakes, often of considerable size, fill many valleys. Many streams have developed deep, steep-walled canyons where they descend the central plateau. The vegetation cover is 100% on the moist slopes, but ranges from 60 to 80% on the ridges.

The Horton Plains Ecodistrict is characterized by highly calcareous loamy to loamy sand till and a moderate to low relief. The plant cover is 80-100%, with bare spots on surfaces susceptible to cryoturbation.

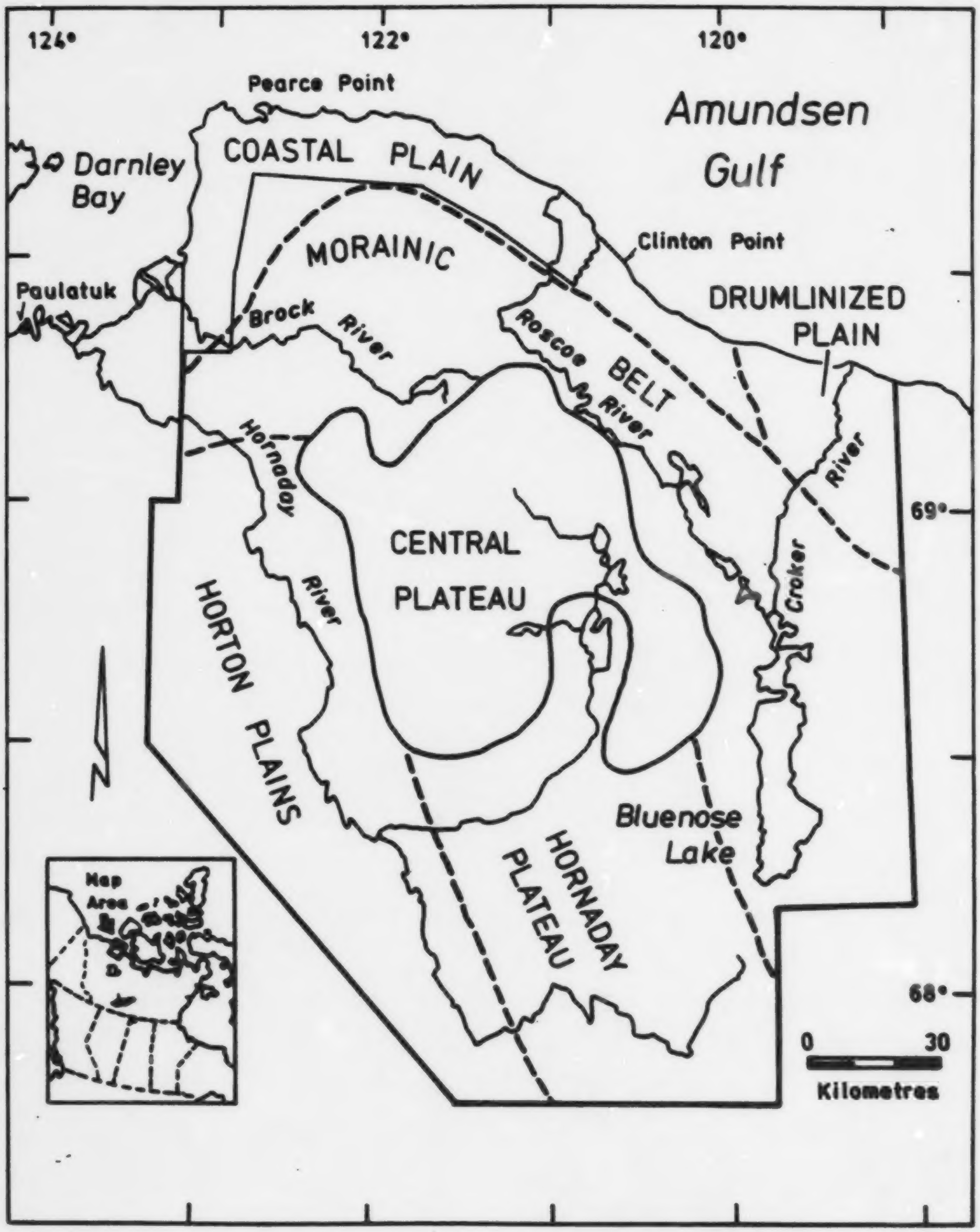
The Hornaday Plateau Ecodistrict is characterized by variable relief: extensive limestone plateaus often grade into gently rolling plains. Many plateaus are ringed with extensive scarps. Vegetation is sparse on bedrock outcrops, and ranges from 60 to 90% on the deeper soils.

10.2 Ecosections

Ecosections were determined on the basis of broad relief, and the texture and thickness of soil materials. The relief classes have significance in indicating the presence of anomalous local climates, as well as the distribution of soil moisture. The textural classes have an important bearing on the moisture and nutrient availability to plants, as well as on the thickness of the active layer. The thickness of unconsolidated soil materials over bedrock influences the rooting depth and moisture content of the soil. The resulting broad vegetation classes were a further criterion for the delineation of the ecosections.

The ecosections of the Melville Hills area differ from one another mainly in the relief and thickness of the soil materials, as both the texture and mineralogy of the materials are similar. Glaciofluvial sands, occurring in glacial spillways or in deltas, are of mappable extent in some areas.

The scale of mapping dictates that few uniform ecosections will be identified on the map. In fact, most are patterns of several soil and vegetation types. Even if different ecosections could be recognized in the field and on air photos, these could not always be mapped because of their small extent. As a general rule, if a different material or vegetation comprised less than 20% of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COASTAL PLAIN
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Paulatuk
Brock River
Roscoe River
DRUMLINIZED PLAIN
Hornaday River
CENTRAL PLATEAU
HORTON PLAINS
Croker River
Bluenose Lake
HORNADAY PLATEAU
Map Area
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Kilometres

Figure 10.1 Ecodistricts of the Melville Hills area

the area, it was not indicated in the symbol. In a complex symbol, the type in the first position is more prevalent than those in subsequent positions. The maps of ecosections and broad vegetation types are enclosed with this report (in pocket). Incomplete air photo coverage resulted in incomplete mapping, especially in the Bluenose Lake area.

Ecosections are intended to characterize the area in broad terms, showing the main relief, soil and vegetation features. This level of detail is perhaps sufficient at a very broad scale of planning, but not at the detailed, management level. Planning for park development must be based on a more detailed map of biophysical features of the area to take advantage of local features that could not be mapped at the broad scale. Such detailed mapping should be an integral part of the planning and development process.

10.3 Terrain Sensitivity

Terrain sensitivity refers to the susceptibility of the terrain to damage as a result of disturbance. The most sensitive terrain will show much reaction to the impact (thermal subsidence, slumping, erosion, etc.) even after relatively low levels of disturbance, whilst the least sensitive terrain will withstand severe disturbances.

Two interrelated kinds of sensitivities can be recognized. One refers to the terrain where the ice content of the soil, soil texture, and slope predispose the terrain to damage. A second aspect is the ability of the vegetation to withstand the effects of disturbance and become re-established.

The susceptibility of the terrain to disturbance in the study area is generally medium to low. This can be attributed to the medium texture of the soil (loam to loamy sand), which results in a relatively low ice content of the near-surface permafrost. The following sensitive terrain types have been recognized:

Sedge meadows -	wet areas that are highly susceptible to rutting by vehicles, or by foot traffic.
Seepage slopes -	slopes that are kept wet by perennial or late-melting snow banks. Roads or trails following the contour would intercept drainage, inducing eventual slope failure.
Polygonal terrain -	polygons indicate the presence of ice wedges below the active layer. The ice wedges would thaw and the surface subside into deep trenches following a severe disturbance.

The sensitivity of vegetation to disturbance is high on wet sites, as trampling would cause severe damage to plants. Dry sites, including bare rock rubble, are not sensitive to foot traffic and are suitable for road location.

Management Considerations

1. Building of facilities on susceptible terrain must be avoided.

2. Foot traffic (such as near campsites) should be concentrated on non-sensitive sites.

3. Traversing well-vegetated seepage slopes by foot trails should be avoided by directing traffic to the ridges.

11. MAMMALS

The Melville Hills are best known as a calving area for the Bluenose caribou herd. They are not known to support unusually high numbers of any other species of mammals, nor an unusually high diversity of species. This likely reflects the rather low habitat diversity of the area, which consists mostly of dry, upland, low-arctic tundra interspersed with few wetlands and watercourses.

Although not included in the proposed Bluenose National Park (Fig. 2.1), marine and forest ecosystems surround the hills to the north and to the south, respectively, and attract additional species which may venture into the proposed park. As a rule, there is little information on the distribution, abundance and ecology of most mammal species of the area.

Twenty-two species of mammals were confirmed to occur in or near the proposed park (Appendix 4). Eighteen additional forest and marine species are probable visitors (Appendix 5). Species considered at risk are listed in Appendix 9. By comparison, 36 species were confirmed to occur in the Anderson-Horton rivers area (Zoltai et al. 1979), where large tracts of subarctic forests occur, and 16 species in the Bathurst Inlet area (Zoltai et al. 1980), which is at least 200 km northeast of the treeline.

In their review of the natural resources of the Anderson-Horton rivers area, Zoltai et al. (1979) have already summarized much information on the mammals that occur on the Melville Hills' west side. In this report, we update some of that information. Our main objective is to review the most characteristic species that occur specifically in or near the proposed Bluenose National Park.

We saw few mammals during our survey (Appendix 4). Some individuals may have been sighted more than once.

11.1 Species of Particular Interest

11.1.1 Barren-ground Caribou

This species is by far the most common large mammal in the Melville Hills. The Bluenose caribou herd ranges between the Mackenzie and Coppermine rivers, and between Great Bear Lake and the Arctic Coast (Fig. 11.1). A photocensus carried out in July 1986 revealed that this herd comprised over 115 200 adults and 18 000 calves (McLean and Russell 1988). Several biologists have attempted to estimate the size of the herd in the last 40 years (see review in Hawley et al. 1979). These estimates varied from 4 500 animals in the mid-1950s to over 90 000 animals in the mid-1970s. Recent surveys (Latour and Heard 1985, Latour et al. 1986) that did not use photography yielded small estimates (30 000 - 50 000 individuals).

Although the exact sites where calving takes place shift yearly, the Melville Hills, and other locales to the west (Fig. 11.2 and 11.3) are traditional calving grounds (Hawley et al. 1979, McLean and Russell 1988). A recent study of calving ground fidelity using radio-collared animals has shown that the average distance moved by adult females in successive years varied between 33 and 44 km (McLean and Fraser 1988).

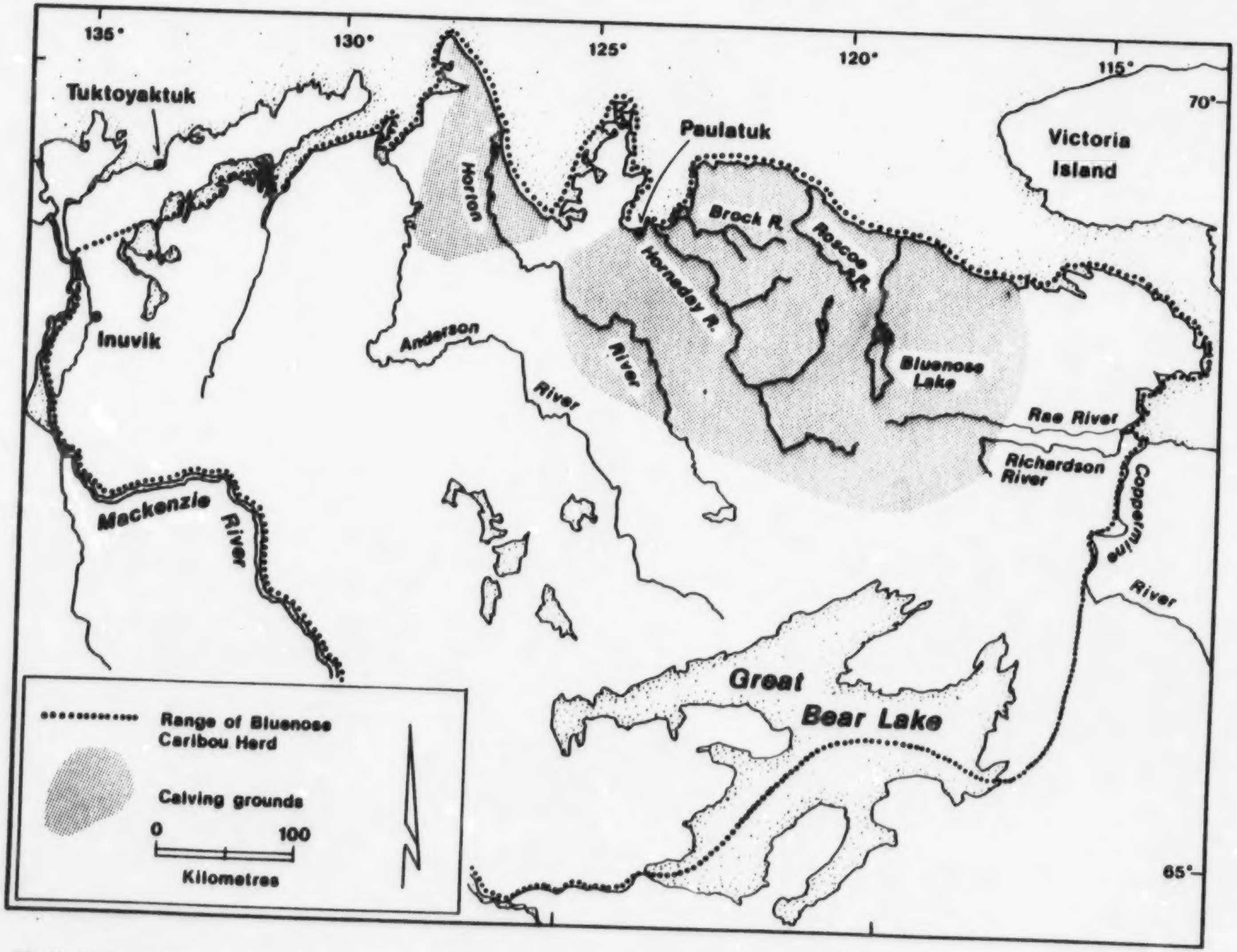
135°
130°
125°
120°
115°
70°
65°
Tuktoyaktuk
Paulatuk
Victoria Island
Horton
Brock R.
Roscoe R.
Hornaday R.
River
Bluenose Lake
Inuvik
Anderson River
Rae River
Richardson River
Coppermine River
Mackenzie River
Great Bear Lake
Range of Bluenose Caribou Herd
Calving grounds
0
100
Kilometres

Figure 11.1 Approximate distribution of the Bluenose caribou herd

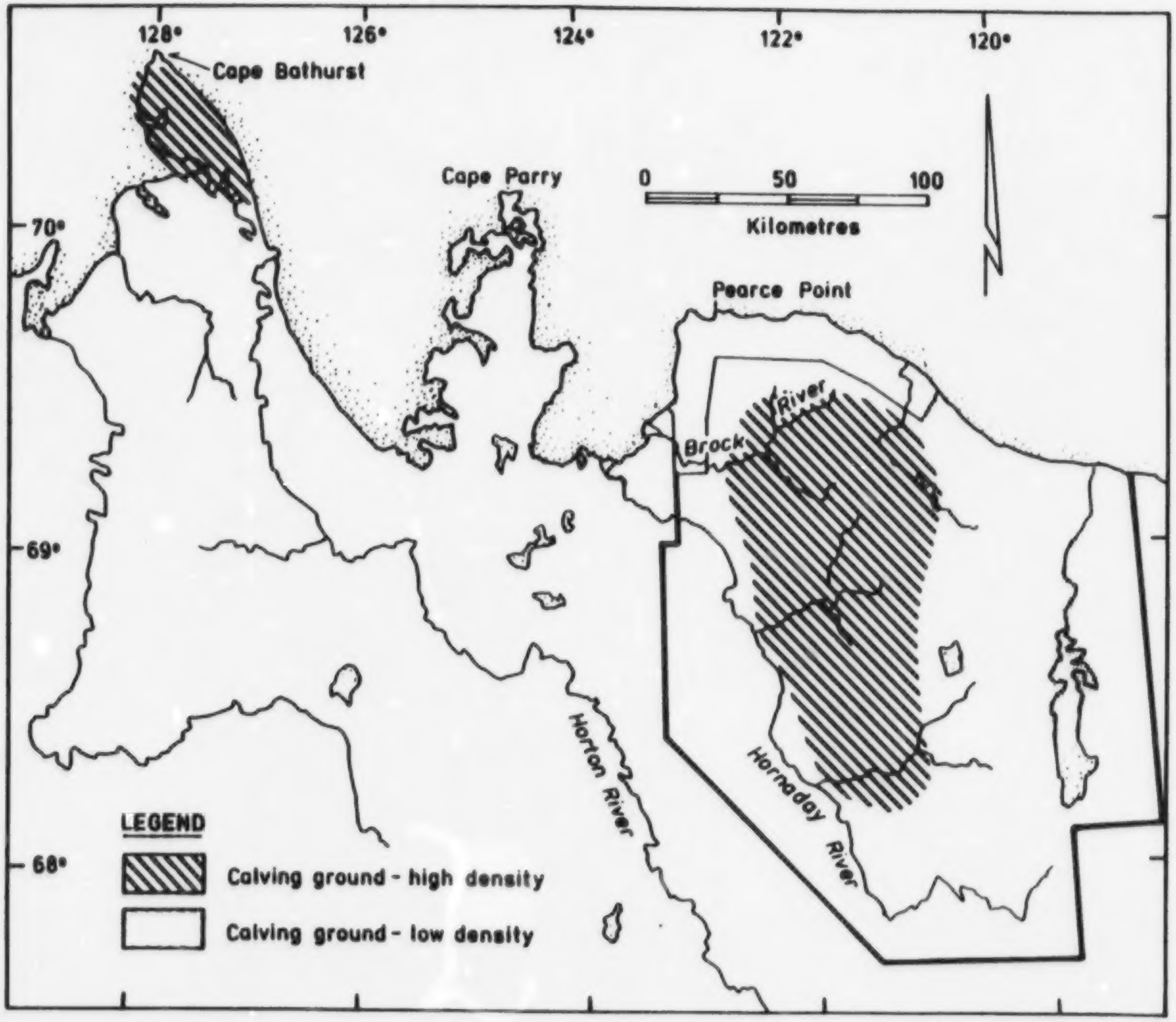
128°
126°
124°
122°
120°
70°
69°
68°
Cape Bathurst
Cape Parry
0
50
100
Kilometres
Pearce Point
Brock
River
Horton River
Hornaday River
LEGEND
▨ Calving ground - high density
☐ Calving ground - low density

Figure 11.2 Preferred calving areas, 19-31 May and 4-6 June 1976 (Hawley et al. 1979)

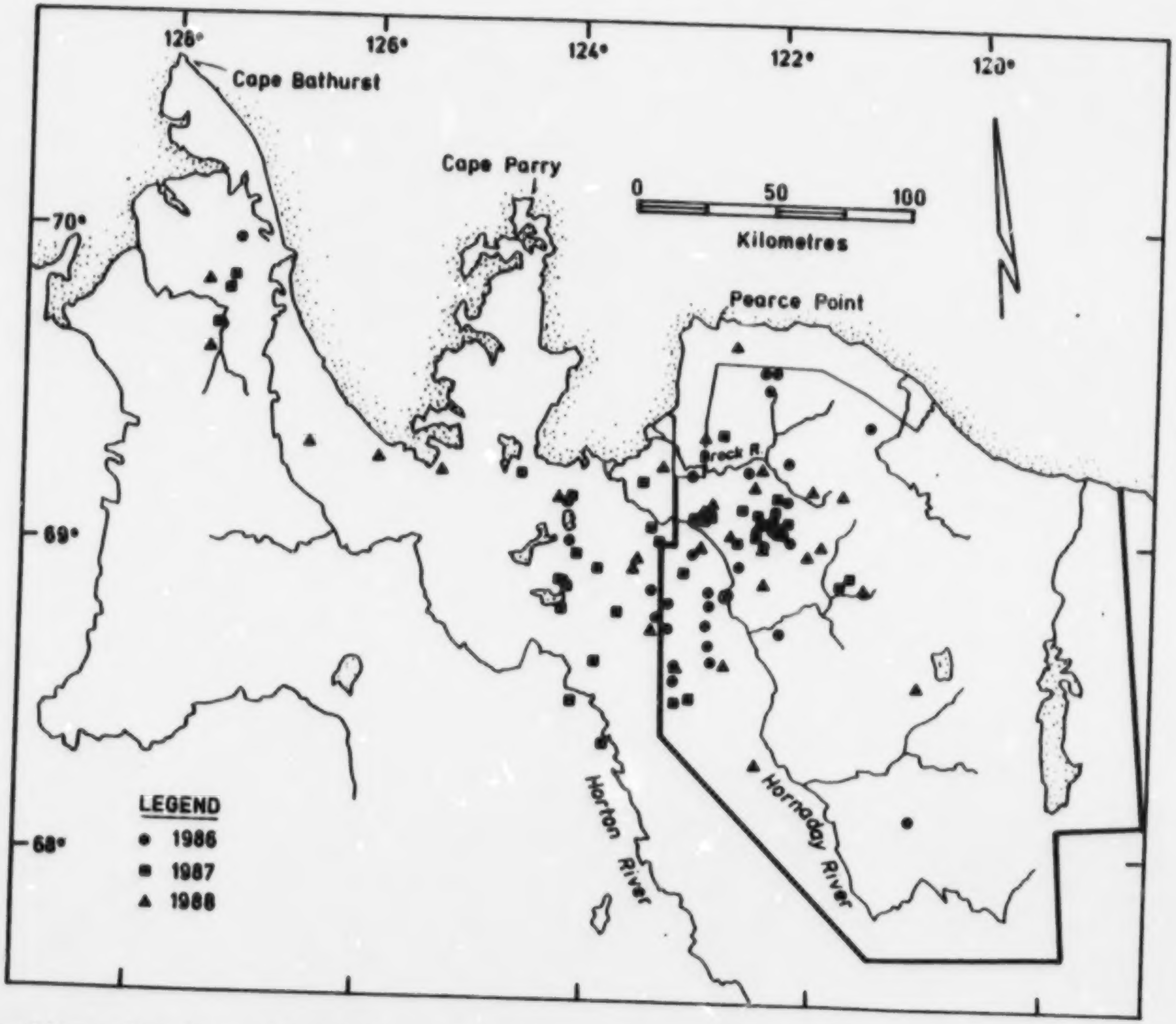
128°
126°
124°
122°
120°
70°
69°
68°
Cape Bathurst
Cape Parry
Pearce Point
0
50
100
Kilometres
Brock R.
Horton River
Hornaday River
LEGEND
● 1986
■ 1987
▲ 1988

Figure 11.3 Locations of radio-collared female caribou on the calving grounds, 6-12 June 1986-1988 (McLean and Russell 1988)

Calving habitat appears good in the Melville Hills, particularly in light of the prevailing windswept, dry and relatively insect-free conditions. However, predators like Golden Eagles and Barren-ground Grizzly Bears are relatively common, but Wolves are not (see below). Although dry and poorly productive tundra occurs over most of the region, there are numerous patches of wet, lush tundra where grazing appears good. Kelsall (1968) has shown through fecal pellet counts that caribou prefer the wetter and better vegetated areas in the Bluenose Lake area.

Part of the Bluenose herd may winter north of the treeline, even along the Arctic Coast, but most of the herd winters south of the treeline, northwest, north and northeast of Great Bear Lake. Northward spring movements can begin in February or March. Calving begins in late May. Large congregations of post-calving animals form in July to disperse later in August. In September and October, the animals coalesce and move to or beyond the treeline where the rut occurs. They continue their movement to the wintering grounds in October and November (Hawley et al. 1979).

We did not see any large group of post-calving caribou during our survey. However, cows and calves (Fig. 11.4) were present in most areas and observed every day, but always in small numbers. Up to 6 000 animals were reported near La Roncière Falls just before our survey (T. Green, pers. comm.).

11.1.2 Muskox

Overhunting nearly caused the disappearance of the Muskox (Fig. 11.5) north of Great Bear Lake by the turn of the century. Over 3 000 hides were traded in Fort MacPherson, Fort Anderson, Fort Good Hope and Fort Norman within a period of 40 years (Barr 1991). Following the enactment of protective legislation by the Canadian government in 1917, numbers of Muskoxen on the NWT mainland rose steadily, even dramatically in some areas (Barr 1991). Numerous surveys have been carried out north of Great Bear Lake in the last two decades (see review in Case and Poole 1985, Barr 1991). Population estimates varied from a few hundred in the 1960s (Kelsall et al. 1971) to a few thousand in the mid-1980s.

Case and Poole (1985) estimated that over 3 300 animals occurred north of Great Bear Lake in 1983. The main concentrations were not observed in the proposed National Park. They were observed to the southwest, along the Horton River, and to the southeast, along the Rae-Richardson rivers. More recent surveys (1987) indicated that there were an estimated 3 040 ± 1 296 animals between the Anderson and Hornaday rivers (McLean 1990), and 1 800 ± 293 animals in the Rae-Richardson river valley (A. Gunn, pers. comm.). These numbers corroborate what Bodden (1980) and Barr (1984) had suggested earlier: this species is of prime significance for the Tundra Hills, the natural region defined by the Canadian Parks Service that includes the Melville Hills. Muskoxen are the second most common large mammal in this region.

The fact that Muskoxen are more abundant on each side of the Melville Hills likely reflects the presence of better foraging habitat in those locations. Tener (1965) indicated that there were about 100 individuals near Bluenose Lake in the 1950s. In light of the increasing numbers north of Great Bear Lake, they

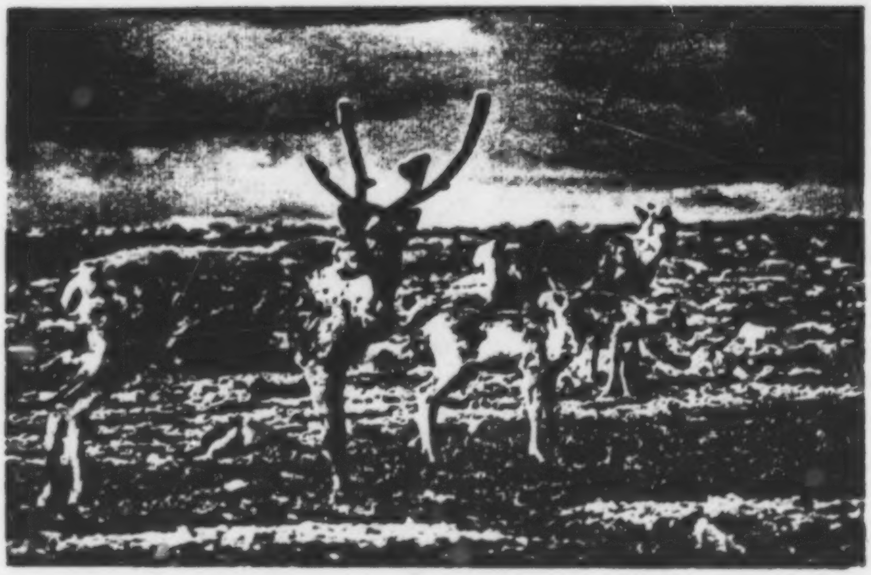

Figure 11.4 Barren-ground caribou of the Bluenose herd

Figure 11.5 Muskoxen on the coastal plain near Croker River

are likely more numerous today, but we observed only 64 animals during our survey.

Unlike caribou, Muskoxen do not undertake long migrations between summer and winter grounds. During the winter, Tener (1965) indicated that they seek windward slopes and hilltops where snow depth is minimal, and where browsing and grazing are easier. However, at Polar Bear Pass, on Bathurst Island, Gray (1987) observed that they remain in the valley, where plant cover is better, but where snow depth is generally less than 30 cm. They push aside soft snow with their nose or break thick snowcrusts with their feet and chin until vegetation in the air-space at ground level is exposed (Gray 1987). Muskoxen locate plants under the snow by smell and they do not dig at random (Gray 1987). Their diet includes a wide variety of shrubs, forbs, grasses and sedges (Tener 1965, Parker 1978). Muskoxen probably feed in the lowlands during winters when the snow is not too deep, but when snow depths limit their foraging in these areas, they probably feed in the higher windswept areas.

11.1.3 Grizzly Bear

This species (Fig. 11.6) was designated "vulnerable" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1991. However, the status of 12 populations that currently occur in North America was reviewed separately, and the Arctic Coastal Plains (Yukon North Slope to Hudson Bay, including the Melville Hills) population was not assigned any risk category (Banci 1991). The current level of the Arctic Coastal Plains population is apparently similar to historical levels. Also, current habitat capability of the zone is roughly equivalent to the historical capability. An estimated 2 860 bears occur in the Arctic Coastal Plains (Banci 1991). The bears that form this population are sometimes referred to as "Barren-ground Grizzly Bears".

Bear density varies between areas of the Arctic Coastal Plains. In Northern Yukon and on the Tuktoyaktuk Peninsula (where nearly half of the landmass is water) bear densities were estimated at 1 bear/37.4 km^2 and 1 bear/211-262 km^2, respectively (Nagy _et al_. 1983). In the Anderson-Horton rivers area, it was estimated at 1 bear/94 km^2 (Clarkson and Liepins 1991a). Grizzly Bear density is unknown in the Melville Hills, but in light of the nature of the terrain, is likely lower than in the more diverse and productive Anderson-Horton rivers area. We saw only 11 bears during our survey.

Samples of scats from the Anderson-Horton rivers area indicated that their diet consists primarily of vegetation (e.g. _Hedysarum_ sp. present in 54% of samples; grass/sedges: 27%). Ground squirrels and caribou were found in 11% and 8% of the samples, respectively (Clarkson and Liepins 1989a).

Grizzly Bears hibernate. On the Tuktoyaktuk Peninsula, most bears apparently enter their den no later than early october (Nagy _et al_. 1983). Adult males and lone females emerge in late April, whereas adult females with cubs emerge in late May. Several winter dens may occur in the Melville Hills but we found none during our survey. One den was reported near Pearce Point (D. Reid, pers. comm.).

Figure 11.6 Grizzly bear with three cubs on the coastal plain

Figure 11.7 Wolf pup at den entrance, Hornaday River valley

Paulatuk hunters have a quota of five bears per year. This quota has not been met lately (Appendix 8).

11.1.4 Polar Bear

This species was not considered at risk in 1986 when Stirling (1986) reviewed its status for COSEWIC. However, in light of its low densities, reproductive rate, and vulnerability to toxic chemicals, it was recently designated "vulnerable" (COSEWIC 1991).

Despite a lack of survey coverage in Amundsen Gulf, the Beaufort Sea/Amundsen Gulf population was estimated to comprise approximately 1 800 individuals, and certainly did not exceed 2 000 individuals in the mid-1980s (Stirling et al. 1988). These numbers are similar to those of the early 1970s, before the decline in the mid-1970s. This decline apparently occurred in response to an even greater decline in the numbers and productivity of two important prey species: Ringed and Bearded seals (Stirling et al. 1982).

The coastline of the Melville Hills region is not known to harbour any denning sites (Urquhart and Schweinsburg 1984). More maternity dens were found along the mainland coast (west of Cape Parry) in the 1980s than in the 1970s, but none were found in this region in either decade (Stirling et al. 1988).

Polar Bears are unlikely to occur near the Melville Hills during the summer and early fall because southern Amundsen Gulf is usually ice-free, and thus, their preferred habitat is not available. During that period, the bears of Amundsen Gulf move north along the west coast of Banks Island and probably migrate as far north as neccessary to remain with the edge of the permanent ice pack (Stirling et al. 1981). During the winter and spring, they are more common immediately to the west, off Cape Parry and Cape Bathurst where polynyas and leads are better developed (Stirling et al. 1981).

Bears can travel over large distances. One bear tagged at Herschel Island, Yukon Territory, was recaptured off Pearce Point (Stirling et al. 1981). However, most bears that travel along the mainland coast of the U.S. and Canadian Beaufort seas usually do not venture east of Cape Bathurst. Most bears found in Amundsen Gulf belong to a different subpopulation that also occurs on the west coast of Banks Island, where maternity dens abound (Stirling et al. 1988).

Paulatuk hunters have a quota of 17 bears per year, but fewer are usually killed (Appendix 8). Hunting usually takes place in the spring, offshore on the ice pack (Anon. 1990). The present number of bears taken in the Beaufort Sea/Amundsen Gulf region is probably at maximum sustained yield (Stirling et al. 1988).

11.1.5 Wolverine

The Wolverine occurs both south and north of the treeline. Banfield (1974) suggested that its centre of abundance is the tundra zone of the Yukon and the Northwest territories. In 1989, COSEWIC designated the western population (west of Hudson Bay) "vulnerable" (Dauphiné 1989). It is at risk because of its low density and low reproductive rate. For example, some measurements obtained by radio-telemetry on the Alaska north slope indicated that males maintain a home range of 625 km^2 (females maintain smaller home ranges) and that females produced only 0.6 young per year on average (Magoun 1985 in Dauphiné 1989).

This species is poorly known in the NWT, but according to harvest estimates, which are the highest of all Canadian jurisdictions (see Dauphiné 1989), it is relatively abundant. Paulatuk hunters usually kill several individuals each year (Appendix 8). In NWT, this species is most abundant in the western and central mainland (A. Gunn, pers. comm. in Dauphiné 1989), an area that includes the Melville Hills. Thousands of Wolverines likely occur in the NWT, where its population is considered stable or increasing.

This omnivorous species is active year-round and is both a predator and a scavenger (Banfield 1974). Wolverines occasionally kill young and adult caribou. They can follow migrating caribou herds, and they clean up carcasses left by wolves and bears (Kelsall 1968).

11.1.6 Wolf

Wolves are uncommon in the Melville Hills and we saw none during our survey. Obst (1990) found only one active den (Fig. 11.7) along the Hornaday River. Wolves are occasional visitors at Pearce Point (Appendix 4). Kelsall (1970) also mentioned that they were unexpectedly scarce near Bluenose Lake.

Preliminary results from a current study in the Inuvialuit Settlement Region and the Melville Hills, indicated that few radio-collared animals occur in the proposed National Park (Clarkson and Liepins 1989b). Most animals, which belong to at least 17 packs, were sighted south and west of Paulatuk, in the treeline-tundra transition zone, where they apparently prefer to den. Most Wolves killed by Paulatuk hunters (Appendix 8) likely came from that area. Only one den is known to occur in the proposed park, likely the one observed by Obst (see above).

Some packs appear restricted to small areas, whereas others appear to follow the major concentrations of caribou and have much larger home ranges (Clarkson and Liepins 1989b). These authors also indicated that in the fall, six packs consumed an average of 3.26 kg of prey/wolf/day. Clarkson and Liepins (1991b) found that for all the packs that they monitored, caribou was the main prey species. The scarcity of Wolves in the Melville Hills likely contributes to attract calving caribou.

11.1.7 Collared Lemming

Small rodents are key components of tundra ecosystems because they are preyed upon by several mammals and birds. However, specific information on their populations and ecology is usually lacking for most Arctic regions; the Melville Hills are no exception. In this perspective, the current lemming study carried out at Pearce Point by the University of British Columbia is noteworthy.

That study focuses on Collared Lemmings, which prefer dry upland tundra, and the role of predators in their population dynamics (D. Reid, pers.

comm.). A vast exclosure that keeps terrestrial and aerial predators away was built. Lemmings can be very prolific, having as many as three litters per summer (D. Reid, pers. comm.). Breeding can take place early in the spring, under the snow, and population levels are known to fluctuate widely over time.

Although this may be a poor indicator of microtine rodent abundance, we saw no lemming or vole, and few signs of their presence, during our survey. Nor did we attempt to capture any. Kelsall (1970) reported that Tundra Voles were abundant and that Collared Lemmings appeared to have been recently numerous when he visited the Bluenose Lake area in 1953. This may have accounted for his numerous sightings of foxes, owls and jaegers. None of these animals were common during our survey, suggesting that small rodent populations were low. Nonetheless, Collared Lemmings and Tundra Voles were commom residents at Pearce Point in 1987-1990 (Appendix 4), where several individuals were trapped and marked (D. Reid, pers. comm.).

11.1.8 Ringed Seal

This small seal (60 -70 kg) is the most common sea mammal in Amundsen Gulf. In 1982, over 70 500 Ringed Seals were estimated to occur in northern Amundsen Gulf, compared to 1 270 Bearded Seals (see Kingsley and Lunn 1983). It occurs year-round near the Melville Hills but in light of its preference for high ice cover and waters of moderate depth (50 - 100 m; Stirling et al. 1982), it is less likely to be seen during the ice-free season. Although he did not survey the coastal waters off the Melville Hills, Smith (1987) indicated that in the Amundsen Gulf area, this species is more common on the west coast of Victoria Island, near Holman. Whereas adults are found in the region year-round, most young seals apparently migrate westward before freeze-up, towards the ice-free waters of the western Beaufort, Chukchi and Bering seas (Smith 1987).

This is the only Arctic seal that can live troughout the winter in land-fast ice (Smith et al. 1991). It maintains breathing holes throughout the winter and spring, and can dig new holes with its paws through ice 45-65 cm thick. It excavates subnivean birth and haul-out lairs where it seeks shelter from predators, and thermal protection for its single pup. Pups are born in the spring and they take advantage of their stable fast-ice habitat and thermal shelter to grow slowly during a relatively long lactation period of 6-7 weeks. This increases the total time invested by the mother, but it appears to be adjusted to her small body size and capacity for blubber storage, and possibly to the limited food resources available to her during the Arctic winter (Smith et al. 1991).

The extremely variable environmental conditions (e.g. the amount and quality of ice cover) that can prevail in regional marine waters were well illustrated by the dramatic fluctuations in the estimated visible population of Ringed Seals (and Bearded Seals) recorded in the eastern Beaufort Sea and western Amundsen Gulf in the past (Stirling et al. 1982).

11.1.9 White Whale or Beluga

The status of the White Whale in the Beaufort Sea/Amundsen Gulf was reviewed by COSEWIC in 1985 (Finley et al. 1985). With over 11 500 individuals, this population is one of the largest in Canada and appears healthy. Contrary to other populations, which are threatened (e.g. Eastern Hudson Bay) or endangered (e.g. Ungava Bay), it was not assigned any risk category. This status is still valid in 1991 (COSEWIC 1991). Belugas are the most common toothed whale in Amundsen Gulf.

These small (up to 6 m long and a weight of 2 t) whales winter in the Bering Sea and migrate into the Beaufort Sea/Amundsen Gulf region from April to June. During spring migration, they travel along leads in the ice pack. Many adults and calves congregate in the Mackenzie River estuary from late June to early August, but some remain widely distributed in the eastern Beaufort Sea and Amundsen Gulf. This includes waters off the Melville Hills where, as suggested by the numbers taken by Paulatuk hunters (Appendix 8), they are not particularly common. Westward movements towards the Bering Sea begin in September and most Belugas have returned to their wintering grounds by November or December (Braham et al. 1984, Finley et al. 1985).

The scarcity of Belugas near the Melville Hills likely reflects the scarcity (compared to the Mackenzie Delta/Tuktoyaktuk Peninsula/Eskimo Lake region) of large estuaries. The Hornaday and Brock estuaries are the only estuaries of any significance in this region. Estuaries are sought by Belugas during the summer apparently as nurseries and places to moult (see review in Finley et al. 1985).

11.1.10 Bowhead Whale

In 1980, COSEWIC designated the Bowhead Whale of the Western Arctic (Bering-Chukchi-Beaufort seas stock) "endangered", based on a population estimate of 2 300 individuals (Anon. 1980). This estimate, based on ground or aerial visual surveys, was probably too low (see Moore and Clarke 1991). More recent figures based on the 1986 combined visual and acoustic census off Point Barrow, Alaska, suggested that this population comprises 8 300 individuals (Raftery et al. 1990). However, these authors added that their estimate may be biased upward. In May 1991, the International Whaling Commission considered the best estimate to be 7 500 animals with a net rate of increase of 3.1% annually (IWC 1991). This estimate was based on the 1988 census, which was the most complete to date and showed less variance than in 1986. Although this population appears healthy and closer to historic levels (12 400 - 18 200 animals in 1848 [see IWC 1991]), it was still considered endangered by COSEWIC in 1991.

On 24 July 1990, three bowheads were seen at Clinton Point (G. Hamre, pers. obs.). This species can apparently be common near the Melville Hills. At least one hundred bowheads were reported off Clinton Point by two employees of the Dew line station in 1977 (Hazard and Cubbage 1982). This suggest that waters off the Melville Hills can provide good foraging conditions. It seems that a typical bowhead requires about 100 t (wet weight) of crustecean food per year, and that it may need to feed in areas where food concentration is 2.0-2.5 g/m^3 (see IWC 1991). Samples of stomach contents from Alaska have shown that this species feeds largely on copepods and amphipods, and that one kind of prey often forms 90% of the contents (IWC 1991).

Bowheads observed in Amundsen Gulf winter in the Bering Sea. They migrate by Point Barrow, Alaska, from April through June, and arrive in Canadian waters from May through July. They return into the Alaskan Beaufort and Chuckchi seas from August through November (Hazard and Cubbage 1982, Braham et al. 1984). They readily take advantage of leads in the ice pack while migrating, but they can also break through ice as thick as 60 cm (George et al. 1989). Their protruding blowhole appears to be an adaptation to living in ice-dominated waters. George et al. (1989) also suggested that they can navigate under ice using ambient light and echolocation. This likely contributed to previous population understimates by visual surveys.

In light of the apparent health of the western Arctic population, a licence to hunt one whale was issued by the federal government to the Inuvialuit of Aklavik, NWT, in August 1991. One young male (12 m long, weight: ca. 38 t) was killed in September 1991, near King Point, Yukon Territory (R. Binder, Inuvialuit Game Council, pers.comm.). With a length up to 18 m and a weight up to 70 t, this slow-swimming, plankton-feeding, baleen whale is by far the largest animal that can be found in the region. If the western Arctic population continues to grow, it will likely become more common in Amundsen Gulf.

11.2 Important Mammal Habitats in or near The Proposed Park Area

The creation of Bluenose National Park was proposed to protect and represent the Tundra Hills natural region, and to protect the calving ground of the Bluenose caribou herd (Harvey 1989). Although little is known about most mammals of the Melville Hills, this review suggests that the Barren-ground Caribou is the most significant species within the proposed park. Thus, the protection of habitats used by calving and post-calving caribou deserve particular attention. They include primarily the dry highlands surrounding the lower half of the Hornaday River and the entire Brock River (Fig. 11.3), and adjacent, small, wet lowlands, where foraging is better. It also includes the highlands and lowlands at and north of Bluenose Lake, along the upper Croker and Roscoe rivers, where lower densities of calving caribou are known to have occurred (Fig. 11.2).

Near the proposed park, the concentrations of Muskoxen in the valleys of the Horton, Rae and Richardson rivers are noteworthy. The health of the small Muskox population in the proposed park is likely linked to that of those found in these nearby valleys. The report of 100 Bowhead Whales at Clinton Point suggests that nearby coastal waters can be important to marine mammals.

12. BIRDS

Compared to other areas of the western Arctic, the Melville Hills have been visited infrequently by ornithologists. In a recent review (Alexander _et_ _al_. 1991), CWS did not identify any key habitat sites for migratory birds in this region because information is generally lacking. As a rule, the dry hills are principally populated by widely scattered landbirds (e.g. larks and longspurs) and shorebirds (e.g. plovers and sandpipers). Significant numbers of birds of prey nest in the region (see below).

12.1 Number of Species

Eighty-one species were confirmed to occur in the Melville Hills (Appendix 6). Most records were made since 1986. They include 47 confirmed breeders and eight suspected breeders. This does not include hypothetical species such as a Barnacle Goose _Branta_ _leucopsis_ apparently shot in Paulatuk by a local hunter many years ago (Clarke 1944), or other species that a larger sampling effort would likely reveal (e.g. Hudsonian Godwit _Limosa_ _haemastica_, Whimbrel _Numenius_ _phaeopus_, Long-billed Dowitcher _Limnodromus_ _scolopaceus_ and Smith's Longspur _Calcarius_ _pictus_).

Nor does this total include marine species that possibly occur in coastal waters (e.g. Thick-billed Murres _Uria_ _lomvia_ and Black Guillemots _Cepphus_ _grylle_). Over 700 murres and 16 guillemots nest at nearby Cape Parry (Fig.2.1), where Common Murres _Uria_ _aalge_ were also reported (Johnson and Ward 1985). Black-legged Kittiwakes _Rissa_ _tridactyla_ and Ivory Gulls _Pagophila_ _eburnea_ occur occasionally along the Beaufort Sea coast (Johnson and Herter 1989) and are just as probable in Amundsen Gulf.

Forest species like the Gray-cheeked Thrush _Catharus_ _minimus_, Gray Jay _Perisoreus_ _canadensis_, Boreal Chickadee _Parus_ _hudsonicus_, and many other species that occur in the Anderson-Horton river area (Zoltai _et_ _al_. 1979), likely occur in the Melville Hills as well. At least six forest species have already been reported: American Robin[1], Yellow-rumped Warbler, American Tree, Lincoln's, White-crowned and Harris's sparrows (Appendix 6).

By comparison, at least 146 species, including four hypothetical species, were recorded in the Anderson-Horton rivers area, which is ecologically more diverse (Zoltai _et_ _al_. 1979). At least 93 species, including three hypothetical and 17 accidental species, were recorded in the Bathurst Inlet area (Zoltai _et_ _al_. 1980). However, both regions have been frequently visited by birdwatchers.

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[1] The scientific names of all species confirmed to occur in the Melville Hills are in Appendix 6.

12.2 The Most Common Summer Residents

No particular sampling technique other than recording all birds seen and heard on the ground and from the air was used during our survey. Despite their inadequacies (e.g. only large species were seen from the air), our records helped identify the most common species.

Over 3 440 birds were recorded. The 20 most recorded species were: Canada Goose (628), Oldsquaw (526), Common Eider (385), Glaucous Gull (191), Lapland Longspur (161), White-winged Scoter (120), Tundra Swan (103), Horned Lark (72), Pacific Loon (60), Lesser Golden-Plover (56), Northern Pintail (47), Red-breasted Merganser (43), American Pipit (41), Semipalmated Sandpiper (36), Arctic Tern (36), Common Merganser (26), Herring Gull (25), Peregrine Falcon (21), Red-throated Loon (20), and Savannah Sparrow (20). All except White-winged Scoter and Common Merganser, which come to this region to moult, are confirmed breeders.

These records, and those of all other species, suggest that the regional avifauna is diverse for an Arctic locale, but that summer bird populations are small.

12.3 Bird Abundance in 1953 and 1990

Records made in 1953 (Kelsall 1970) and our observations suggest that the abundance of some species is variable. Kelsall (1970) saw only two small migratory flocks of Canada Geese at Bluenose Lake in 1953. In 1990, we saw over 600 geese, including 145 moulting adults and goslings on Bluenose Lake. This apparent increase likely results from the growth of the continental Canada Goose population in the last 40 years. It has more than tripled since 1955, and now comprises more than 3.7 million individuals (USFWS 1988, Bortner et al. 1991). The Short Grass Prairie population, to which these geese belong, has nearly quintupled since 1969. It comprised 536 000 individuals in 1990 (Bortner et al. 1991).

Kelsall (1970) saw several nesting Snowy Owls. He also mentioned that voles and lemmings were abundant and accounted for all the bones found in owl regurgitation pellets. In 1990, we saw only three Snowy Owls and no vole or lemming, suggesting that the abundance of these species is correlated, and that owl and rodent populations were low in 1990. Several cycles of low and high abundance may have occurred between 1953 and 1990.

At least four other species were apparently much more common in 1953 than in 1990: Rock and Willow ptarmigans, and Long-tailed and Parasitic jaegers. These species were seen frequently by Kelsall (1970), but we recorded only 2, 12, 5 and 8 individuals, respectively. Although ptarmigan populations are known for undergoing periodic fluctuations, and low jaeger populations may be related to low rodent populations, the assessment of what caused low populations in these species in 1990 lies beyond the scope of this survey. Hunting statistics (Appendix 8) suggest that ptarmigans were more common in the region in the recent past. Obst (1990) also reported that his observations of Willow Ptarmigan and Rock Ptarmigan declined by over 79 and 38% along the Hornaday River, between 1988 and 1990. He also recorded declines along the Horton River.

12.4 Species of Particular Interest

12.4.1 Peregrine Falcon

No specimen was taken and no subspecies was positively identified, but we assume that these falcons were Tundra Peregrines, Falco peregrinus tundrius, (see Cade et al. 1988). This subspecies was downlisted from threatened to vulnerable by COSEWIC in 1992 (C.C. Shank, pers. comm.). It was designated threatened in 1978, following a continent-wide decline caused by pesticides (Martin 1978).

Peregrine Falcons (Fig. 12.1, 12.2) are currently common in the Melville Hills, where they appear to be under no particular environmental threat. As suggested by the number of known nesting sites along the nearby Horton River, which went from 10 to 23 between 1968 and 1988 (Fyfe et al. 1975, Obst 1988), it is possible that there are more falcons here as well, compared to 20 years ago. Further east near Bathurst Inlet and Coppermine, falcon numbers have also increased between 1982 and 1990 (Shank et al., in press). Nonetheless, in light of this subspecies' habit of migrating to South America (Martin 1978, A.O.U. 1983), it remains exposed to countless hazards.

At least 46 pairs, including 27 pairs along the Hornaday River alone, nest in the region (Fig. 12.3; Obst 1990 & pers. comm., 1991, D. Reid, pers. comm., and our observations). There are probably as many unknown pairs in the cliffs that remained unsurveyed (J. Obst, pers. comm.). As suggested by Obst (1990), when eggs or young were found, or when both adults showed nest defense behaviour (nests without eggs or young are apparently not defended by adults), it was considered a productive territory. When at least one adult was frequently seen at a nest site which showed signs (fresh prey remains, feathers and droppings) of being occupied, it was considered an occupied territory. If no sign of recent occupation was seen at a formerly occupied nest, it was defined as an unoccupied territory. These definitions apply to all other raptors dicussed below.

Falcon density was particularly high in the canyon of the Hornaday River, where mean distance (n = 10) between active nests was 1.6 km. The nests were in cliffs from three to 100 m high. Most occupied territories in 1988 were reoccupied in 1990. In some cases, alternative sites within 100 - 1 600 m were used (Fig. 12.3). Two to four eggs, and two or three young were found in the nests. Obst (1990) estimates that local falcons initiate egg laying as early as 3 June, that eggs hatch as early as 5 July, and the young fledge as early as 6 August.

Over 85% of 131 prey remains collected at six productive nests were of shorebirds and passerines (Obst 1990). Remnants of Lesser Golden-Plover (Fig. 12.4) and Lapland Longspurs were particularly common. Remnants of ptarmigans, ground squirrels, voles, lemmings and trout were also identified.

In light of the uncertain taxonomic status of falcon subspecies in northern Canada, and the poorly defined status of the national population of Tundra Peregrines (Bromley, in prep.) the significance of this population cannot be assessed with certainty. Available figures (Kiff 1988: 448 confirmed pairs for

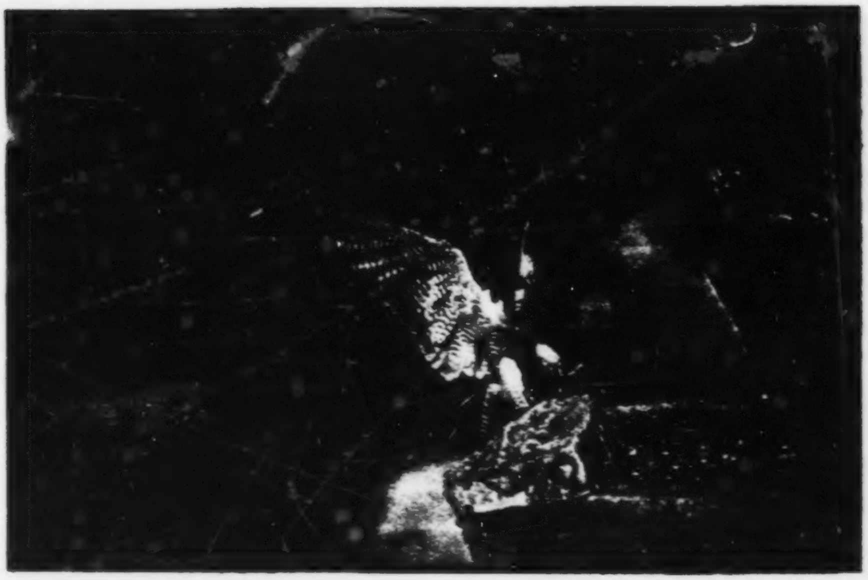
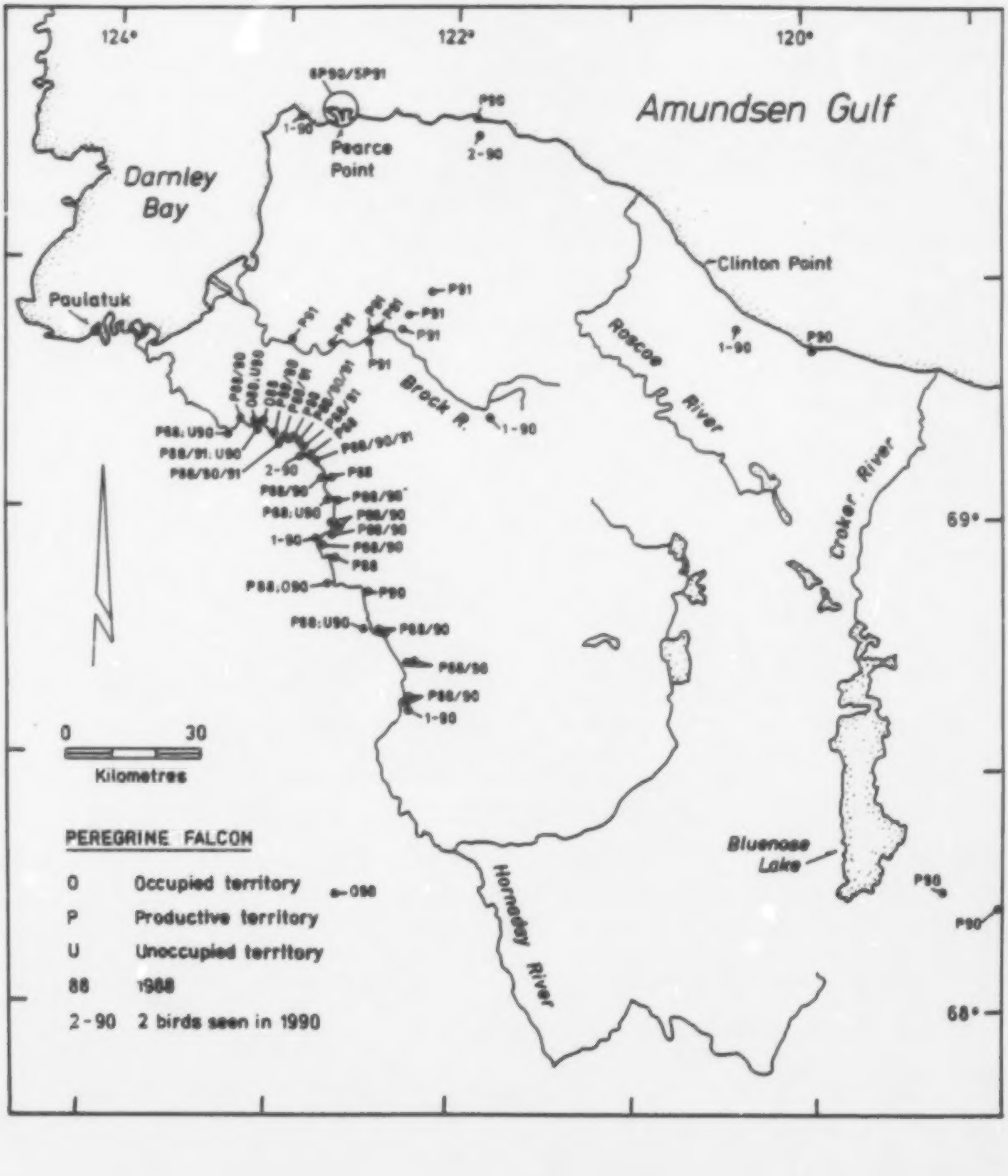


Figure 12.1 Peregrine Falcon at its nest

Figure 12.2 Young Peregrine Falcon


124°
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Amundsen Gulf
Darnley Bay
Paulatuk
Pearce Point
SP90/SP91
1-90
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Clinton Point
Brock R.
Roscoe River
Croker River
Hornaday River
Bluenose Lake
P91
P91
P91
P91
P91
P91
1-90
P90
1-90
P88/90
O90.U90
P88.U90
P88/91.U90
P88/90/91
P88/90/91
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P88
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P90
P90
0 30
Kilometres
PEREGRINE FALCON
O Occupied territory
P Productive territory
U Unoccupied territory
88 1988
2-90 2 birds seen in 1990
O90

Figure 12.3 Locations of known Peregrine Falcon nesting territories, 1988-1991

for Arctic and Subarctic Alaska and Canada; Bromley, in prep.: 680 nest sites known to have been occupied in the past in the NWT) suggest that well over 1% of this subspecies' national population breeds in the Melville Hills.

12.4.2 Gyrfalcon

Gyrfalcons are less common than Peregrines in the Melville Hills. Only 13 nesting sites, nine of which are along the Hornaday River, are known (Fig. 12.4; Obst 1990 & pers. comm., 1991). Productivity was very low in 1990, when less than a third of the pairs found in 1988 were breeding. Obst (1990) suggested that a decline in the regional ptarmigan population, and adverse weather immediately before hatching may have caused this low productivity.

This species is much more common along the Horton River where at least 31 occupied nest sites were found (Obst 1988). Nesting habitat is apparently less suitable along the Hornaday River, particularly along the upper half of the river. In the lower half, in the canyon, the density of Gyrfalcons (mean distance between active nests = 5.3 km [n = 7]) is high and comparable to that of the Horton River. In contrast to the latter area, where as many as one third of the pairs nest in trees (J. Obst, pers. comm.), all pairs nested on cliffs. Eggs are usually laid in the first half of May and hatch 35 days later. The young often fledge before the end of July (Obst 1990).

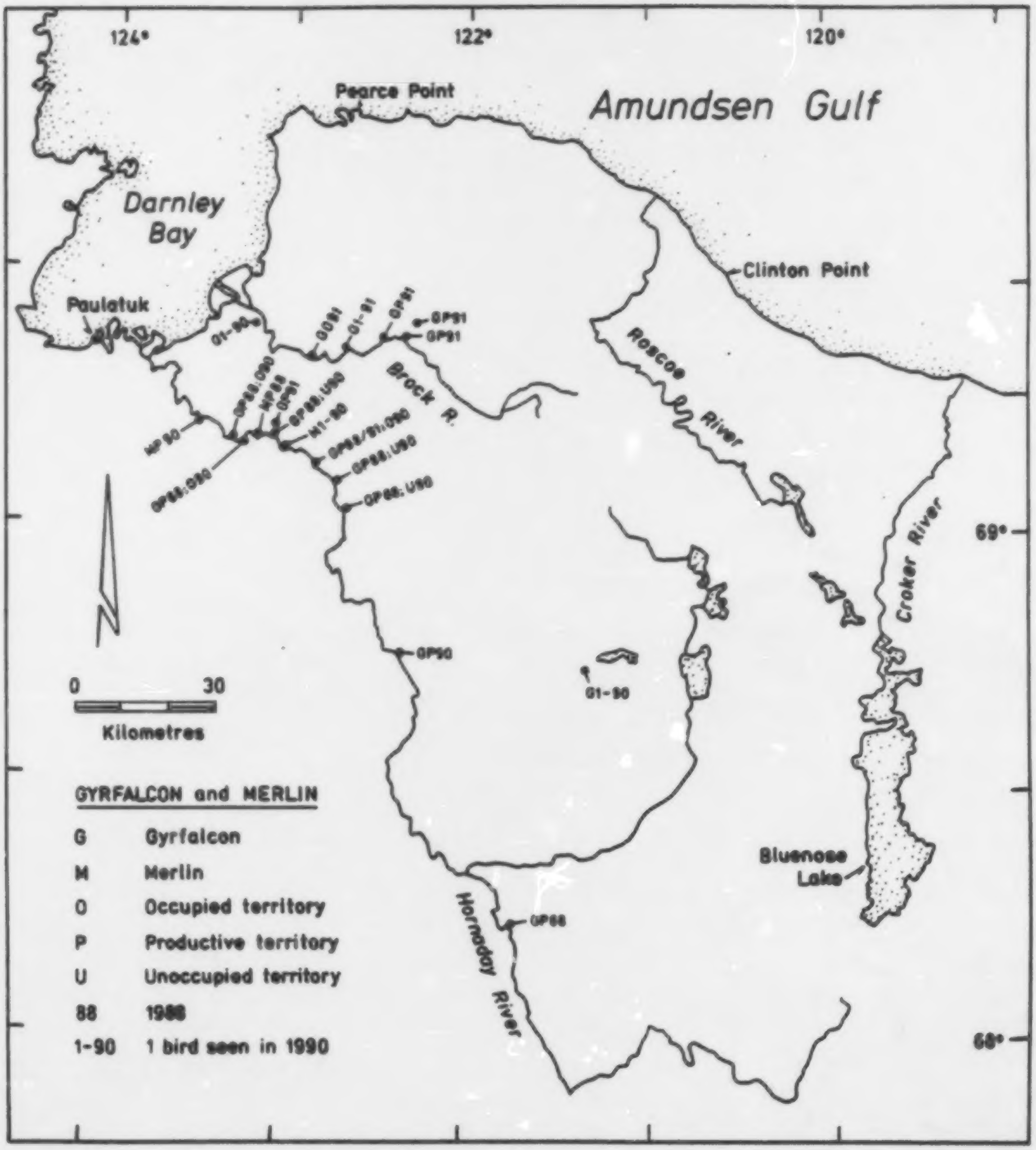
All birds observed were of the gray phase. Prey remains at nest sites included mostly ptarmigans and ground squirrels. In years when prey are abundant, Gyrfalcons can winter in their breeding range (Platt 1976).

The NWT Gyrfalcon population is unknown but is certainly much larger than the Yukon's, which was estimated to comprise 700-800 pairs (Bromley 1987). The NWT population appears healthy and stable and this species was not considered at risk by COSEWIC in 1987.

12.4.3 Merlin

One pair was confirmed to breed along the Hornaday River in 1988 and 1990, but at different locations (Fig. 12.4; Obst 1990). This species does not normally breed north of the treeline (A.O.U. 1983, Godfery 1986). The 19 territories found along the Horton River were all south of or near the treeline (Obst 1988).

Merlin populations and productivity have apparently increased in North America in recent years after declines caused by pesticides in the 1950s and 1960s (de Smet 1984). This species is not considered at risk by COSEWIC although it may be still exposed to pesticides on its wintering grounds, which extend from southern Canada to northern Peru, including the Caribbean Basin (A.O.U. 1983). The current growth in the continental population suggests that Merlins may become more common north of the treeline.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Amundsen Gulf
Darnley Bay
Paulatuk
Clinton Point
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GP91
Brock R.
Roscoe River
MP90
GP88;O90
MP88
GP91
GP88;U90
M1-90
GP88/91;O90
GP88;U90
GP88;U90
GP88;O90
69°
Croker River
GP90
G1-90
0
30
Kilometres
GYRFALCON and MERLIN
G Gyrfalcon
M Merlin
O Occupied territory
P Productive territory
U Unoccupied territory
88 1988
1-90 1 bird seen in 1990
Bluenose Lake
Hornaday River
GP88
68°

Figure 12.4 Locations of known Gyrfalcon and Merlin nesting territories, 1988-1991

12.4.4 Golden Eagle

At least 26 nesting territories were found, 16 of which were on the Hornaday River (Fig. 12.5; Obst 1990 & pers. comm., 1991; D. Reid, pers. comm., and our observations.). Of 15 territories found in 1988, two thirds of which were productive, over 80% were reoccupied in 1990, but only one third of them were productive (Obst 1990). The apparent decline in the regional population of ptarmigans, combined with adverse weather during incubation, may have caused this lower productivity in 1990 (Obst 1990).

Eagles begin to lay their eggs in late April or early May. The eggs usually hatch by mid-June and the young fledge in the second half of August (Obst 1990). Their local diet consists mainly of ptarmigans and ground squirrels, but also includes microtine rodents, waterfowl, hare and caribou calves (Obst 1990). One nestling (Fig. 12.6) is known to have killed and eaten half of its younger sibling despite the presence of a fresh caribou carcass in the nest (Obst 1990).

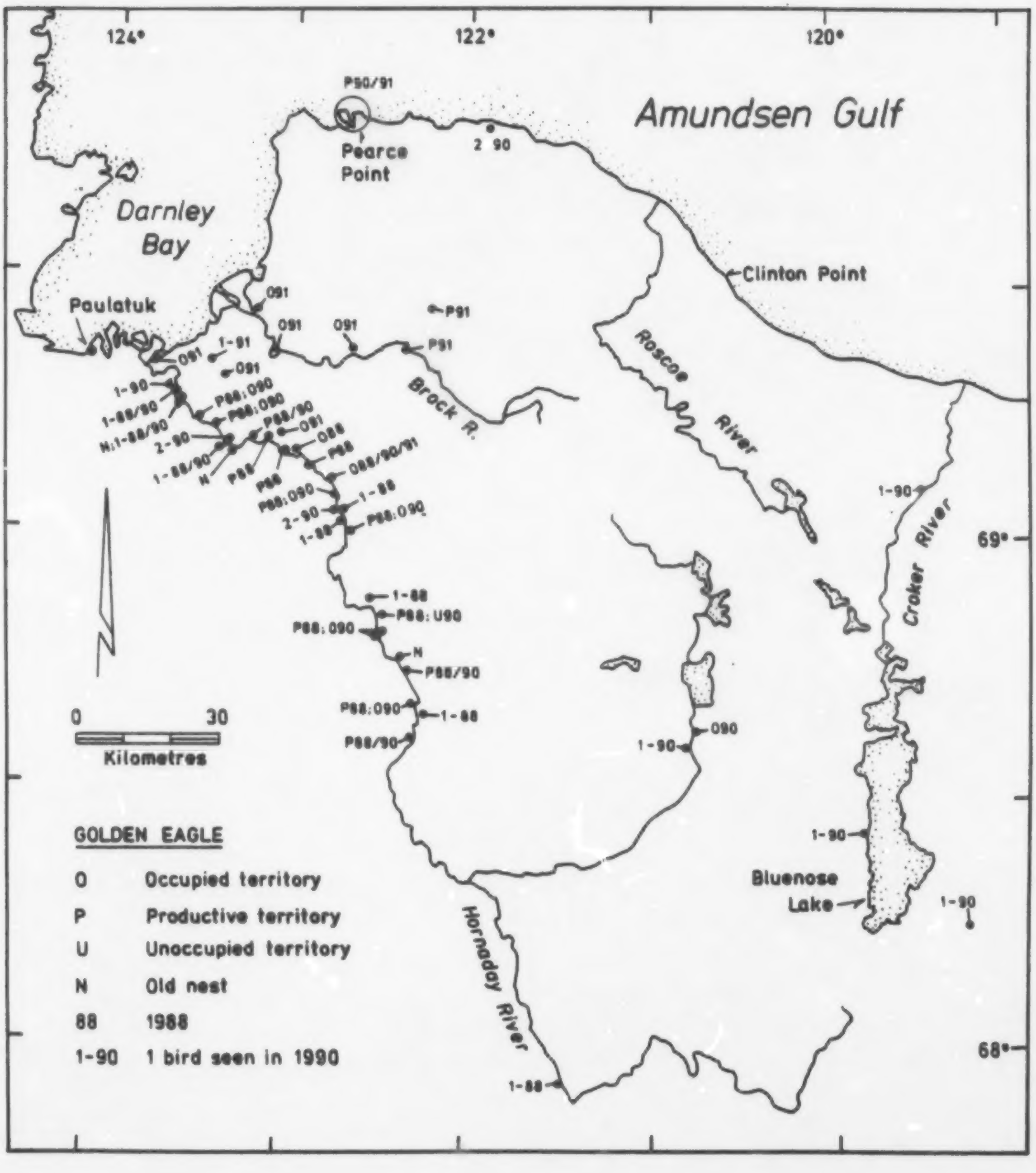
Like Gyrfalcons, Golden Eagles are more common along the Horton River, where at least 24 nesting territories were found (Obst 1988). The NWT and regional populations of this large, common raptor are unknown but are apparently not at risk. As suggested by Godfrey (1986), this species may winter in the region. They likely do so when prey is sufficiently abundant.

12.4.5 Rough-legged Hawk

At least 38 pairs were found (Fig. 12.8; Obst 1990 & pers. comm., 1991; D. Reid, pers. comm., and our observations.) and many more pairs likely occur. Most territories found in 1988 and 1990 were productive, but fewer were productive in 1990 (Obst 1990). This lower productivity was probably caused by lower populations of microtine rodents (Obst 1990). Prey remains found at active nests were mainly of voles and lemmings. The Short-eared Owl, another confirmed breeder that depends largely on microtine rodents, was also observed less frequently in 1990 than in 1988 (Obst 1990).

From observations of nestlings in July, Obst (1990) estimated that egg laying occurs in late May or early June. The mean distance between eight productive nests on the Hornaday River was 6.8 km in 1988. This species is also common in the Anderson-Horton rivers area (Zoltai *et al*. 1979). Obst (1988) found 18 active or productive territories along the Horton River in 1987. In contrast to the Horton River where some nests were easily accessible, all nests on the Hornaday River were on cliffs three to 60 m high and difficult to access. Ground-nesting pairs may occur in the Melville Hills. At Toker Point, on the Tuktoyaktuk Peninsula, all nests were on the ground (Sirois and Dickson 1989).

The NWT population of this species is unknown but appears healthy. This species winters in southern Canada, in the United States, and sometimes in northern Mexico (A.O.U. 1983).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Paulatuk
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Roscoe River
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Croker River
Hornaday River
Bluenose Lake
69°
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P88;090
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P88;090
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P88;U90
P88;090
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P88;090
1-88
P88/90
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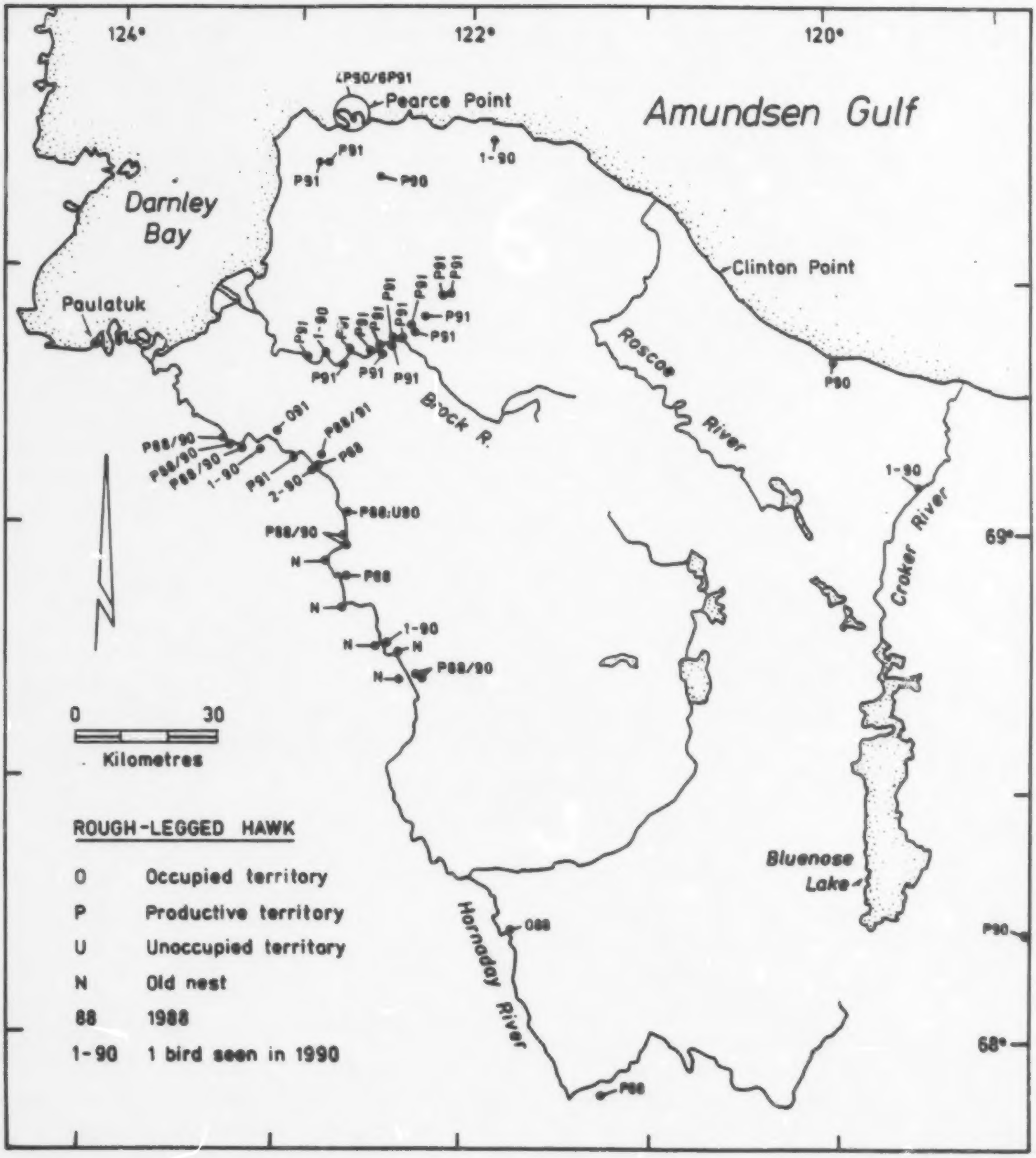
090
1-90
1-90
1-90
1-88
0
30
Kilometres
GOLDEN EAGLE
O Occupied territory
P Productive territory
U Unoccupied territory
N Old nest
88 1988
1-90 1 bird seen in 1990

Figure 12.5 Locations of known Golden Eagle nesting territories, 1988-1991

Figure 12.6 Young Golden Eagle

Figure 12.7 Young Tundra Swans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Paulatuk
Clinton Point
Roscoe River
Brock R.
Croker River
Bluenose Lake
Hornaday River
0
30
Kilometres
ROUGH-LEGGED HAWK
O Occupied territory
P Productive territory
U Unoccupied territory
N Old nest
88 1988
1-90 1 bird seen in 1990
P91
P90
1-90
O91
P88/91
P88
P88/90
P88:U90
2-90
N
O88
P88/90

Figure 12.8 Locations of known Rough-legged Hawk nesting territories, 1988-1991

12.4.6 Canada Goose

This is the most common breeding goose, but it is not abundant. Our survey suggests that no more than 200 pairs nest in the proposed park. In the Inuvialuit Settlement Region Canada Geese are much more common west of Paulatuk, particularly on the Parry Peninsula (Hines and Westover 1991, Hines et al. 1992). As indicated in section 12.3, Canada Geese were apparently much less common in the past, before the dramatic growth of the Short Grass Prairie population (Bortner et al. 1991).

We mostly observed flocks of swimming adults and goslings. No goose was seen in flight, suggesting that all adults were moulting. Flocks of adults only were also seen. These may have been failed breeders, or perhaps non-breeders from other regions that came here to moult. Although dry upland tundra dominates the region, goose moulting and breeding habitat (wet tundra where grazing is good and waterbodies) is abundant enough to attract larger numbers of geese than we saw in 1990. If the Short Grass Prairie population continues to expand, Canada Geese may become more common.

Canada Geese, Snow Geese and Greater White-fronted Geese are among the most hunted birds by Paulatuk hunters (Appendix 8). Most of these geese are likely migrants that breed elsewhere in the western Arctic. The Short Grass Prairie population of Canada Geese migrate through the western NWT, the Prairie provinces, and the short grass zone of the North American Great Plains. It winters in Colorado, New Mexico, Oklahoma and Texas (Bortner et al. 1991).

12.4.7 Greater White-fronted Goose

This is a rare breeder (J.E. Hines, pers. comm.), and we saw none during our survey. This species is more common during migration, as suggested by hunting statistics (Appendix 8; N.B.: bird hunting takes place mostly during migration [T. Green, pers. comm.]). In the western Arctic, it breeds principally in coastal areas west of the Parry Peninsula to the Mackenzie Delta. The population of the Inuvialuit Settlement Region is currently being assessed; it may include over 75 000 individuals (Hines and Westover 1991). It winters moslty along the Texas coast, and in Mexico (Bortner et al. 1991).

12.4.8 Lesser Snow Goose

This species is not known to breed in the Melville Hills (J.E. Hines, pers. comm.) but it is one of the most commonly killed birds by Paulatuk hunters (Appendix 8). Snow Geese occur during migrations, and most likely come from Banks Island, where over 98 250 pairs (Kerbes 1988), or 95% of the western Arctic population, have nested in the past. These geese winter in Colorado, New Mexico, Texas and northern Mexico (Bortner et al. 1991).

Only small numbers of blue-phase Snow Geese and Ross's Geese nest among the white Snow Geese of Banks Island (Barry 1961, Dzubin 1979), and few were killed by local hunters (Appendix 8).

12.4.9 Tundra Swan

Several scattered nesting pairs were observed throughout the region during our survey. We observed over 100 individuals, including adults and cygnets (Fig. 12.7). Swans are much more common west of the Parry Peninsula, and in the Mackenzie Delta (Hines and Westover 1991). There could be over 20 000 swans in the Inuvialuit Settlement Region (J.E. Hines, pers. comm.).

Clearly, waterfowl habitat is marginal in the Melville Hills compared to coastal lowlands to the west. Nonetheless, nesting swans are numerous enough to be observed regularly. These swans, like all those that belong to the continental eastern population (97 400 individuals in 1991 which breed from the Seward peninsula, Alaska, to Baffin Island, NWT) winter on the U.S. Atlantic coast, from Maryland to North Carolina (Bortner et al. 1991).

12.4.10 Oldsquaw

Our observations and hunting statistics (Appendix 8) suggest that this small diving bird is the most common duck in this region. Several females and young were observed on inland waterbodies, where they sometimes formed crèches. Hundreds of postbreeding males and nonbreeding females were also seen in coastal waters (e.g. Pearce Point), where they were moulting with other seaducks.

It is probably the most common waterfowl in the western Arctic, with tens of thousands of nesters and moulters (Johnson and Herter 1989). These birds winter mostly in the ice-free waters of the Bering Sea, and further south along the Pacific coast (A.O.U. 1983). Some migrate inland and may winter in the Great Lakes (Johson and Herter 1989).

12.4.11 Common Eider

The Common Eider of the western Arctic (Somateria mollissima v-nigra) is also called the Pacific Eider (Barry 1986). We observed mostly moulting males (less than 400) in coastal waters, at the base of cliffs near Pearce Point, where eiders also nest (D. Reid, pers. comm.). We occasionally observed female eiders inland, but they may have been King Eiders. Overall, there appears to be few nesting Pacific Eiders in the Melville Hills, as suggested by Barry (1986).

Barry (1986) indicated that this eider is much more common to the west (Parry Peninsula), to the east (Dolphin and Union Strait), and to the north (west side of Victoria Island). He suggested that the total Canadian population of this subspecies comprises over 80 000 birds. If birds from the U.S. Beaufort Sea are added, the North American population comprises probably twice as many birds (Johnson and Herter 1989).

Eiders are among the earliest and latest waterbirds to migrate in the western Arctic. They arrive in April and leave in November, as soon and as long as open water is available in coastal areas or in offshore leads in the ice pack (Barry 1986, Alexander et al. 1988, Johnson and Herter 1989). They usually lay their eggs in mid-June and fledging occurs from late August through October. This population winters mostly in coastal Alaska, in the Bering sea, south of the ice pack (A.O.U 1983).

12.4.12 White-winged Scoter

We observed over 100 White-winged Scoters during our survey. All were in coastal waters, often with other seaducks. Most were males and appeared unable to fly. No evidence of nesting was observed. This species apparently migrates into this region during the summer to moult. It is a common moulter further west (Alexander et al. 1988, Johnson and Herter 1989). It nests west of the Melville Hills (Zoltai et al. 1979), usually south of the treeline (Martell et al. 1984, Godfrey 1986). The western, continental population of this species winters principally in coastal Alaska, Britsh Columbia, and further south (A.O.U. 1983, Godfrey 1986). Two other less common species appear to come here only to moult: Surf Scoter and Common Merganser.

12.4.13 Common Raven

We saw few ravens (six in total) during our survey, as did Obst (1990) in 1988 (nine), and in 1990 (eight), who also confirmed that few pairs nested along the Hornaday and Brock rivers. Except for Pearce Point, where it is said to be common (Appendix 6), this species is uncommon. Ravens are assumed to be year-round residents, as they are in other arctic locales (A.O.U. 1983, Godfrey 1986). They are probably the earliest nesters. In nearby areas, nest initiation is known to have occurred in April (Johnson and Herter 1989). They are known to initiate nesting during the winter in more southern latitudes (Heinrich 1989). At Yellowknife, NWT, most winter roosts are disbanded in late February or early March, when the adults return to their breeding territories (J.S., pers. obs.).

Given its habit of nesting in large stick nests on cliffs, it may occasionally compete with local raptors for nest sites. It is an omnivorous scavenger and predator. It can prey on large birds and mammals, including adult ptarmigans and reindeer calves (Heinrich 1989). It associates readily with caribou herds and is well known for "cleaning up" carcasses left by other predators (Kelsall 1968).

12.4.14 Northern Wheatear

J. Obst (pers. comm.) observed one pair repeatedly carrying insects into a small rock crevice along the Hornaday River (at 69° 06'N, 122° 43'W), in June 1988. The crevice was too deep to allow him to see a nest, but his observations suggest that the adult birds were feeding nestlings. We consider this sighting a confirmed breeding record.

Wheatears have been confirmed to breed at many locations in the Canadian Arctic (Godfrey 1986), but they are rare. There appears to be only one other confirmed breeding record for the Mackenzie District of the NWT, at Cache Creek, on the west side of the Mackenzie Delta (Salter et al. 1980). It is an uncommon migrant and breeder in the Beaufort Sea area (Johnson and Herter 1989).

These birds likely belong to the subspecies Oenanthe oenanthe oenanthe, which also occurs in Alaska and Yukon and winters in areas like northern China (A.O.U. 1983).

12.4.15 Common and Hoary redpolls

We could not identify with certainty most of the redpolls (Fig. 12.9) that we observed. Most appeared to be hybrids, as defined by Troy (1985), who suggested that both species should be merged in a single taxon. However, what appeared to be typical adults of both species were confirmed to breed. Adults were often observed feeding fledglings. They were always in low shrubbery, in small or large valleys.

Hoary Redpolls can winter on their breeding grounds, north of the treeline (Godfrey 1986), and some may remain in the Melville Hills year-round. Like other small diurnal birds that winter at high latitudes, redpolls may rely on nocturnal hypothermia (see Reinertsen 1983), among other adaptations, to survive through the long, cold and dark winters.

12.4.16 Rock and Willow ptarmigans

We observed only two Rock Ptarmigans and 14 Willow Ptarmigans during our survey. These numbers were unexpectedly low, in light of the numbers taken by local hunters (Appendix 8). As indicated in section 12.3, Obst's (1990) observations suggested that ptarmigan populations have been declining lately. We suspect that the dry upland tundra that dominates the Melville Hills provides marginal foraging habitat for ptarmigans, compared to the Horton-Anderson rivers area.

Both species are important as many other birds and mammals prey on them. As in other Arctic regions (see Godfrey 1986, Johnson and Herter 1989), both species may winter in the Melville Hills, and accordingly some of their predators (Gyrfalcon, Golden Eagle) may do the same. In order to conserve energy during the winter, ptarmigans may spend up to 21 hours a day burrowed in the snow (Andreev 1991).

12.4.17 Tundra passerines

They were not recorded as the most common birds (section 12.3), but small ground-nesting passerines like Horned Larks, American Pipits, Savannah Sparrows, Lapland Longspurs and Snow Buntings, were the most widespread and probably the commonest birds. Hundreds appeared to occur throughout the region's upland tundra, which is the most widespread habitat regionally. In contrast with larger birds, which were also seen and recorded from the aircraft, small passerines were only recorded on the ground.

Our observations and those of Obst (1990) indicated that Lapland Longspurs were the most abundant, followed by Horned Larks, American Pipits, Savannah Sparrows and Snow Buntings. Along the Brock and Hornaday rivers, Snow Buntings were sometimes particularly common (J. Obst, pers. comm.). Since passerine populations can fluctuate widely over time (Robbins et al. 1986), this order of abundance may vary. Longspurs and sparrows appeared to favour more

Figure 12.9 Redpoll on its nest

Figure 12.10 A Lesser Golden-Plover

vegetated areas, whereas larks and buntings were often in areas virtually devoid of vegetation. Pipits occurred principally in rocky areas along watercourses. As suggested by prey remains of Peregrine Falcons (Obst 1990), falcon abundance appears largely related to the abundance of these birds.

12.4.18 Shorebirds

Despite the occurrence of at least 17 species (21% of all recorded species; Appendix 6), including nine confirmed breeders, and except for Lesser Golden-Plovers (Fig. 12.10) and Semipalmated Sandpipers, shorebirds were not common during our survey. More breeding sandpipers may have been found had lush, wetter lowlands been searched more thoroughly and earlier in the breeding season. Except for the Hornaday and Brock deltas, where large tidal flats occur, little prime foraging habitat is available to transient or migrating shorebirds.

12.5 Important Bird Habitats in or near the Proposed Park

Significant numbers of cliff-nesting birds of prey in general, and Peregrine Falcons in particular, occur in the region. Nonetheless, except for the cliffs on the Hornaday and Brock rivers, most of the inland and coastal cliffs remain unsurveyed. They likely support many more pairs. Our observations indicate that even small, isolated and apparently insignificant bluffs support nesting raptors.

Bluenose Lake is the largest freshwater body of the region and by virtue of its size, supports relatively large numbers of waterbirds (geese, ducks and loons). However, we did not see an unusual concentration and diversity of birds there. The lowlands near the lake appear to provide good habitat for many shorebird species, but this remains to be assessed during the early part of the summer. Overall, the Bluenose Lake area provides typical, rather than exceptional, waterbird habitat and is significant only by virtue of its size.

In the immediate vicinity of the proposed park, the deltas and associated estuarine lagoons and tidal flats of the Hornaday and Brock rivers are suspected to attract large numbers of birds during migrations. To our knowledge, this has never been specifically documented. Our observations in 1990, and a CWS survey in June 1991 (J.E. Hines and S.E. Westover, pers. comm.) indicated that few waterbirds occur there in the summer. This contrasts sharply with the thousands of swans, geese and ducks reported to nest there by others (Department of Fisheries and the Environment 1977).

During the summer, the largest concentrations of birds occur in coastal bays and lagoons (e.g. Pearce and Keats points), where dozens of gulls and loons, and hundreds of moulting ducks occur. However, this does not compare with other sites in the western Arctic, where tens of thousands of ducks may moult (Barry et al. 1981, Barry and Barry 1982). Coastal waters are also outside the proposed park.

13. FISHES

There is little published information on the Melville Hills' ichthyofauna, and traditional knowledge on fish biology and ecology held by local residents has apparently never been systematically compiled. In their review of the Tundra Hills (Natural Region #15 as defined by the Canadian Parks Service; includes the Melville Hills), Bodden (1980) and Barr (1984) indicated that up to 23 species of fish occur in this region. Their review focused on freshwater species because this natural region does not include marine waters. Nor does the proposed Bluenose National Park, which lies in the northwestern corner of the "Tundra Hills".

At least 21 species (Appendix 7) have been captured in or near the proposed park, most of which are either freshwater or anadromous species. Freshwater species known to occur in the Tundra Hills that were not captured include the Lake Chub *Couesius plumbeus*, Trout-Perch *Percopsis omiscomaycus*, Chum Salmon *Oncorhyncus keta* and White Sucker *Catostomus commersoni.* In contrast to other marine species, the Starry Flounder was confirmed to have been caught in a river (Sutherland and Golke 1978). Flounders are known to occur in brackish or freshwater, and are noteworthy for their tolerance to low salinities (Hart 1973). Pacific Herring, Arctic Cod and Saffran Cod were apparently caught in marine waters near Paulatuk.

At least six species are or can be anadromous, including the Arctic Lamprey, Arctic Char, Arctic Cisco, Least Cisco, Inconnu and Arctic Rainbow Smelt. Some of the remaining freshwater species also tolerate brackish water, like the Round Whitefish, Broad Whitefish and Nine-spine Stickleback. The dominance of the Salmonidae, which include char, trout, ciscos, whitefish, and grayling, is an obvious feature of the regional ichthyofauna. The fact that one third of the freshwater species are anadromous also suggests that concerns about marine ecosystems, which are not included in the proposed park, should be fully addressed in future management plans.

Regionally, Arctic Char is among the most captured species by local fishermen (Appendix 8). Captures are particularly high in August, when the annual upstream migration from the sea occurs (MacDonnell 1986, 1989). Much remains to be documented about char in this region: e.g. locations of best spawning and wintering habitat, causes and amplitude of yearly fluctuations in migration period and migrating populations, whether some individuals spawn and winter in the same river every year, importance of landlocked populations, etc. Even population size appears unknown for many if not most rivers in the region.

Despite recent declines caused by generous commercial quotas (6 800 kg/year round weight) between 1968 and 1986, the char population of the Hornaday River is apparently the largest in the region. It is estimated to include just over 16 000 individuals (MacDonnell 1986, 1989). The average commercial harvest was approximately 5 120 kg/year in 1977-1986, but the yearly catch declined markedly at the end of this period (MacDonell 1986). No commercial fisheries have taken place since 1987, but a domestic fishery has been maintained (see Appendix 8). The impact of the domestic fishery on the recovery of the population is unknown (MacDonnell 1989).

A recent attempt to determine the size of the char population of the Brock River remained inconclusive (MacDonnell 1989). However, compared to the Hornaday River, far fewer char appear to use this river. Whether the char of the Hornaday, Brock, and other rivers in the region belong to the same population is unknown. To our knowledge, the char populations of the Roscoe and Croker rivers are unknown. For more information see McPhail and Lindsey (1970), Scott and Crossman (1973) and Hart (1973).

14. SUMMARY AND RECOMMENDATIONS

The Melville Hills area is a typical, rather than an exceptional area of the Canadian mainland Arctic, although it has some interesting and unique features. The uniqueness is evident in the postglacial development of the biota, as the central portion of the Melville Hills apparently acted as a refugium for the biota during the last glacial advance.

The general conclusion of the authors is that whilst the area is representative of the larger Tundra Hills region, it displays a degree of uniqueness that may qualify it for a National Park. The abundance of caribou and of birds of prey is sufficiently high to justify the designation of the area as a National Wildlife Area as well.

14.1 Representativeness of the Area

The greatest majority of the area has physical and biotic attributes which are commonly found in the mainland Arctic. Some of the outstanding or exceptional features, however, make the area worthy of consideration. Some of the biotic features are sensitive to disturbance and need the protection afforded by a national park status.

14.1.1 Summary of Outstanding Abiotic Features

The central part of the Melville Hills which escaped glaciation at least during the latest glacial period makes this area unique on the mainland Arctic. The only comparable area is the unglaciated part of northern Yukon.

Almost all streams, large or small, have cut deep canyons into the bedrock as they descend from the uplands. Whilst these are spectacular, they also discourage canoe or foot travel (Figs. 14.1, 14.2).

One spectacular pingo occurs along the southwestern boundary of the study area. This steep-sided pingo, almost entirely bare of vegetation, is a landmark in the otherwise featureless plain.

14.1.2 Summary of Outstanding Biotic Features

The Melville Hills are in important calving ground for the Bluenose caribou herd. The protection of the calving grounds is imperative to maintain the viability of this herd. The huge masses of migrating caribou are an unforgettable sight for the visitor.

There is a remarkable concentration of Tundra Peregrine Falcons in the area. They use the numerous steep cliffs and canyon walls as nesting sites. The area probably plays an important role in stabilizing the numbers of this vulnerable subspecies.

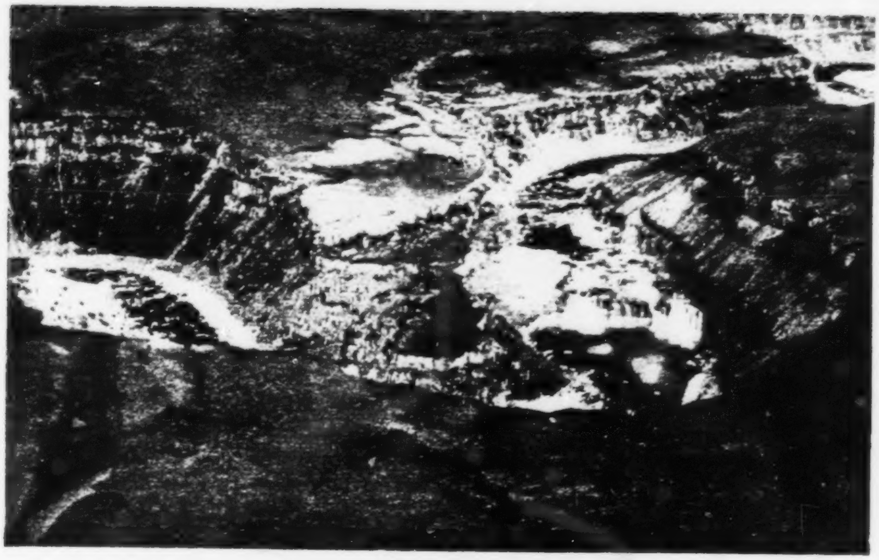

Figure 14.1 La Roncière Falls and part of the Hornaday Canyon

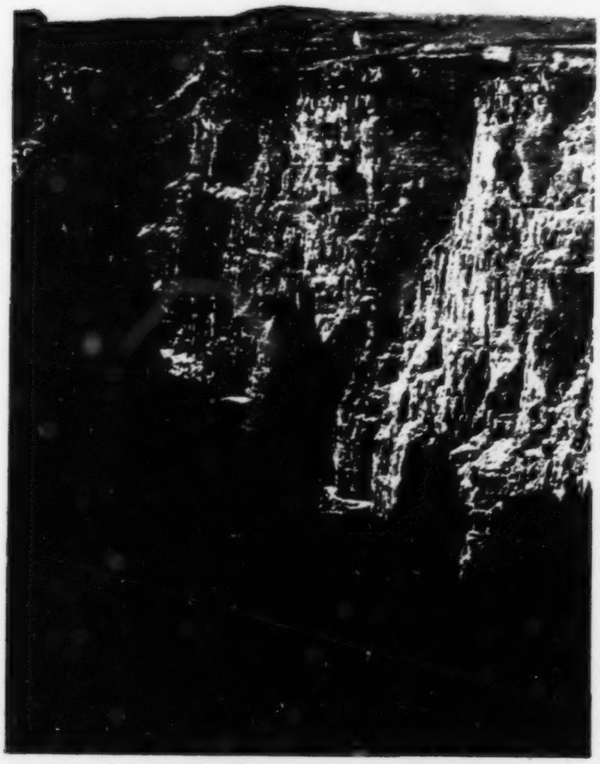

Figure 14.2 Part of the Brock River Canyon

The flora is unexpectedly rich in species. Although vast areas support basically the same vegetation, rich niches can be found in some valleys or on slopes. Such areas occur along the lower Hornaday and Brock valleys and their tributaries. A number of disjunct High Arctic plants occur on the central plateau, making this area particularly interesting for phytogeographers.

14.2 Recommended Boundary

The boundary of the study area, as shown on the 1:250,000 maps, is the preferred boundary for a National Park. The inclusion of the coastal plain and of Bluenose Lake, the largest lake in the region, would favour the protection of several biotic and abiotic resources that greatly enhance the heritage values of the proposed park.

14.3 Management Considerations

The management of the biotic resources of a National Park require a comprehensive knowledge of the status and dynamics of those resources. These needs are presented here in the form of recommendations:

1. The Canadian Parks Service, in collaboration with other agencies, undertake a monitoring program of the calving grounds of the Bluenose caribou herd in order to assess further the significance of the Melville Hills as a calving area.

2. The Canadian Parks Service, in collaboration with other agencies, undertake a comprehensive survey of the population of birds of prey, particularly Peregrine Falcons, within the proposed park area. Survival and productivity of these populations should also be determined.

3. The Canadian Parks Service, in collaboration with other agencies, monitor the status of the regional population of muskoxen, and that a special effort be directed at determining the size of the population within the proposed park.

4. The adjacent marine waters (e.g. a 1-km wide strip), and the Brock and Hornaday estuaries, which are not part of the proposed park, be considered as a buffer zone and managed accordingly. This would provide better protection to scores of waterbirds, shorebirds, sea mammals, and anadromous fish which enhance the natural values of the proposed park.

5. The Canadian Parks Service, in collaboration with other agencies, undertake to study the populations of anadromous and landlocked fish species in and near the proposed park in order to determine the basic biological and ecological characteristics of these populations, and to identify strategic habitats.

6. The Canadian Parks Service, in collaboration with interested parties (government agencies, universities, etc.) compile and publish a report on traditional knowledge held by Paulatuk residents on wildlife species (e.g. best habitats, seasonal distribution and abundance of mammals, birds and fish, migratory patterns, etc.) that occur in or near the proposed Bluenose National Park.

A uniqueness of national importance is the possibility that the core of the Melville Hills area may have escaped glaciation and served as refugium for the biota. To resolve the present uncertainty, we recommend that:

1. The Canadian Parks Service, in collaboration with other agencies, undertake a comprehensive study of the Quaternary geology of the central part of the Melville Hills.

2. In conjunction with the above study, the distribution of plants be studied to determine the extent to which this area had served as a refugium during the Quaternary period.

3. The ancient "driftwood" on the shore of Hornaday Lake is a truly non-renewable resource that should be protected from destruction such as burning by campers.

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Appendix 1. Bryophytes of the Melville Hills region, Northwest Territories.

HEPATICAE

- PSEUDOLEPICOLEACEAE
    - *Blepharostoma trichoplyllum* (L.) Dum.

- PLAGIOCHILACEAE
    - *Plagiochila arctica* Bryhn & Kaal.

- JUNGERMANNIACEAE
    - *Anastrophyllum minutum* (Schreb.) Schust.
    - *Chandonanthus setiformis* (Ehrh.) Lindb.
    - *Lophozia binsteadii* (Kaal.) Evans
    - *L. rutheana* (Limpr.) Howe
    - *Tritomaria quinquedentata* (Huds.) Buch

- SCAPANIACEAE
    - *Scapania simmonsii* Bryhn & Kaal.

- ANEURACEAE
    - *Aneura pinguis* (L.) Dum.

- MARCHANTIACEAE
    - *Marchantia polymorpha* L.
    - *Preissia quadrata* (Scop.) Nees

MUSCI

- SPHAGNACEAE
    - *Sphagnum nemoreum* Scop.
    - *S. russowii* Warnst.
    - *S. teres* (Schimp.) C. Hartm.

- DITRICHACEAE
    - *Ceratodon purpureus* (Hedw.) Brid.
    - *Distichium capillaceum* (Hedw.) BSG
    - *Ditrichum flexicaule* (Schwaegr.) Hampe

- DICRANACEAE
    - *Dicranum elongatum* Schwaegr.
    - *D. spadiceum* Zett.
    - *Oncophorus wahlenbergii* Brid.

- ENCALYPTACEAE
    - *Encalypta alpina* Sm.
    - *Encalypta rhaptocarpa* Schwaegr.

Appendix 1. Continued.

POTTIACEAE

- *Bryoerythrophyllum recurvirostrum* (Hedw.) Chen
- *Desmatodon leucostoma* (R.Br.) Berggr.
- *Didymodon asperifolius* (Brid.) CSA
- *D. rigidulus* var. *icmadophila* (C. Muell.) Zand.
- *Gymnostomum aeruginosum* Sm.
- *Tortula norvegica* (Web.) Lindb.
- *T. ruralis* (Hedw.) GMS

GRIMMIACEAE

- *Grimmia anodon* BSG
- *G. plagiopodia* Hedw.
- *Rhacomitrium lanuginosum* (Hedw.) Brid.
- *Schistidium andreaeopsis* Ochyra & Afonina
- *S. apocarpum* Hedw.
- *S. rivulare* (Brid.) Podp.
- *S. tenerum* (Zett.) Nyh.

SPLACHNACEAE

- *Aplodon wormskjoldii* (Hornem.) R.Br.
- *Splachnum sphaericum* Hedw.
- *S. vasculosum* Hedw.
- *Tetraplodon mnioides* (Hedw.) BSG
- *T. pallidus* Hag.
- *T. paradoxus* (R.Br.) Hag.
- *Voitia hyperborea* Grev. & Arnott

BRYACEAE

- *Bryum algovicum* C. Muell.
- *B. argenteum* Hedw.
- *B. calophyllum* R.Br.
- *B. cyclophyllum* (Schwaegr.) BSG
- *B. pseudotriquetrum* (Hedw.) GMS
- *B. weigelii* Spreng.
- *B. wrightii* Sull. & Lesq.
- *Leptobryum pyriforme* (Hedw.) Wils.
- *Pohlia cruda* (Hedw.) Lindb.
- *P. nutans* (Hedw.) Lindb.

MNIACEAE

- *Cinclidium arcticum* (BSG) Schimp.
- *C. latifolium* Lindb.
- *Cyrtomnium hymenophylloides* (Hueb.) Kop.
- *C. hymenophyllum* (BSG) Holmen
- *Mnium thomsonii* Schimp.
- *Plagiomnium ellipticum* (Brid.) Kop.
- *P. medium* (BSG) Kop.

Appendix 1. Continued.

AULACOMNIACEAE
- *Aulacomnium acuminatum* (Lindb. & H. Arnell) Kindb.
- *A. palustre* (Hedw.) Schwaegr.
- *A. turgidum* (Wahlenb.) Schwaegr.

MEESIACEAE
- *Meesia triquetra* (Richt.) Aongstr.
- *M. uliginosa* Hedw.

CATOSCOPIACEAE
- *Catoscopium nigritum* (Hedw.) Brid.

BARTRAMIACEAE
- *Conostomum tetragonum* (Hedw.) Lindb.
- *Philonotis fontana* var. *pumila* (Turn.) Brid.

TIMMIACEAE
- *Timmia megapolitana* ssp. *bavarica* (Hessl.) Brass.
- *T. norvegica* Zett.
- *T. sibirica* Lindb. & H. Arnell

ORTHOTRICHACEAE
- *Orthotrichum anomalum* Hedw.
- *O. speciosum* Sturm

THELIACEAE
- *Myurella julacea* (Schwaegr.) BSG
- *M. tenerrima* (Brid.) Lindb.

LESKEACEAE
- *Pseudoleskeella tectorum* (Brid.) Broth.

THUIDIACEAE
- *Thuidium abietinum* (Hedw.) BSG
- *T. recognitum* (Hedw.) Lindb.

AMBLYSTEGIACEAE
- *Calliergon giganteum* (Schimp.) Kindb.
- *C. sarmentosum* (Wahlenb.) Kindb.
- *C. stramineum* (Brid.) Kindb.
- *C. trifarium* (Web. & Mohr) Kindb.
- *Campylium arcticum* (Williams) Broth.
- *C. stellatum* (Hedw.) C. Jens.
- *Drepanocladus aduncus* (Hedw.) Warnst.
- *D. lycopodioides* var. *brevifolius* (Lindb.) Moenk.
- *D. revolvens* (Sw.) Warnst.
- *D. uncinatus* (Hedw.) Warnst.
- *Scorpidium scorpioides* (Hedw.) Limpr.
- *S. turgescens* (T. Jens.) Loeske

Appendix 1. Continued.

BRACHYTHECIAEAE
- *Brachythecium turgidum* (C.J. Hartm.) Kindb.
- *Tomenthypnum nitens* (Hedw.) Loeske

ENTODONTACEAE
- *Orthothecium chryseum* (Schultes) BSG
- *Orthothecium strictum* Lor.

HYPNACEAE
- *Hypnum bambergeri* Schimp.
- *H. procerrimum* Mol. (17).
- *H. revolutum* (Mitt.) Lindb.
- *H. vaucheri* Lesq.
- *Ptilidium ciliare* (L.) Hampe

HYLOCOMIACEAE
- *Hylocomium splendens* (Hedw.) BSG

POLYTRICHACEAE
- *Polytrichum alpinum* Hedw.
- *P. juniperinum* Hedw.
- *P. strictum* Brid.

Appendix 2. Lichens of the Melville Hills region, Northwest Territories.

Acarospora veronensis Mass.
Adelolechia pilati (Hepp) Hertel & Hafellner
Agyrophora lyngei (Schol.) Llano
Alectoria ochroleuca (Hoffm.) Mass.
Aspicilia alboradiata (Magn.) Oxner
A. caesiocinerea (Nyl. ex Malbr.) Arn.
A. candida (Anzi) Hue
A. disserpens (Zahlbr.) Räs.
A. elevata (Lynge) Thoms.
A. lesleyana (Darb.) Thoms.
A. perradiata (Nyl.) Hue
A. plicigera (Zahbr.) Räs.
A. ryrkaipiae (Magn.) Oxner
A. supertegens Arn.
Arctoparmelia separata (Th. Fr.) Hale
Bacidia bagliettoana (Mass. & DeNot. in Mass.) Jatta
B. siberiensis (Willey) Zahlbr.
Bryocaulon divergens (Ach.) Kärnef.
Bryoria nitidula (Th. Fr.) Brodo & Hawksw.
Buellia notabilis Lynge
B. papillata (Sommerf.) Tuck.
B. punctata (Hoffm.) Mass.
Caloplaca cinnamomea (Th. Fr.) Oliv.
C. fraudans (Th. Fr.) Oliv.
C. holocarpa (Hoffm.) Wade
C. jungermanniae (Vahl) Th. Fr.
C. tiroliensis Zahlbr.
C. tominii Savicz
Candelariella aurella (Hoffm.) Zahlbr.
C. dispersa (Räs.) Hakul.
Catillaria athallina (Hepp) Arn.
Cetraria cucullata (Bell.) Ach.
C. ericetorum Opiz
C. islandica (L.) Ach.
C. nigricascens (Nyl. in Kihlm.) Elenk.
C. nivalis (L.) Ach.
C. tilesii Ach.
Cladina mitis (Sandst.) Hale & Culb.
C. stellaris (Opiz) Brodo
Cladonia amaurocraea (Flörke) Schaer.
C. coccifera (L.) Willd.
C. deformis (L.) Hoffm.
C. gracilis (L.) Willd. ssp. *gracilis*
C. pleurota (Flörke) Schaer.
C. pocillum (Ach.) O. Rich.
C. pseudorangiformis Asah.

Appendix 2. Continued.

Collema glebulentum (Crombie) Degel.
C. limosum (Ach.) Ach.
C. tenax (Sw.) Ach.
C. tuniforme (Ach.) Ach. em. Degel.
C. undulatum Laurer ex Flotow var. *granuliforme* Degel.
Dactylina arctica (Richards.) Nyl.
D. madreporiformis (Ach.) Tuck.
D. ramulosa (Hook.) Tuck.
Dermatocarpon miniatum (L.) D.C.
Dimelaena oreina (Ach.) Norm.
Evernia divaricata (L.) Ach.
E. perfragilis Llano
Fulgensia bracteata (Hoffm.) Räs.
Haematomma lapponicum Räs.
Hypogymnia subobscura (Vainio) Poelt
Ionaspis melanocarpa (Krempelh.) Arn.
Lecania arctica Lynge
L. fuscella (Schaer.) Körb.
Lecanora atrosulphurea (Wahlenb.) Ach.
L. badia (Hoffm.) Ach.
L. beringii Nyl.
L. candida (Anzi) Hue
L. crenulata Hook.
L. epibryon (Ach.) Ach.
L. hageni (Ach.) Ach.
L. marginata Schaer.
L. nordenskioldii Vainio
L. polytropa (Hoffm.) Rabenh.
L. rupicola (L.) Zahlbr.
L. saligna (Schrad.) Zahlbr.
L. zosterae (Ach.) Nyl.
Lecidea atrobrunnea (Ram. ex Lam. & DC.) Schaer.
L. lactea Flörke ex Schaer
L. lapicida (Ach.) Ach.
L. lithophila (Ach.) Ach.
L. lulensis Hellb.
L. paupercula Th. Fr.
L. plana (Lahm. in Körb.) Nyl.
L. ramulosa Th. Fr.
L. tessellata Flörke
L. theodori Lynge
L. umbonata (Hepp) Mudd
Lecidella euphorea (Flörke) Hertel
L. spitzbergensis (Lynge) Hertel & Leuck.
L. stigmatea (Ach.) Hertel & Leuck.
Leciographa muscigenae (Anzi) Rehm.
Lopadium pezizoideum (Ach.) Körb.

Appendix 2. Continued.

Melanelia elegantula (Zahlbr.) Essl.
M. septentrionalis (Lynge) Essl.
M. stygia (L.) Essl.
Micarea denigrata (Fr.) Hedl.
Nephroma arcticum (L.) Torss.
Ochrolechia frigida (Sw.) Lynge
O. upsaliensis (L.) Mass.
Orphniospora moriopsis (Mass.) Hawksw.
Pachyospora verrucosa (Ach.) Mass.
Parmelia omphalodes (L.) Ach.
P. sulcata Tayl.
Parmeliella tryptophylla (Ach.) Müll. Arg.
Peltigera aphthosa (L.) Willd.
P. lepidophora (Nyl.) Vainio
P. malacea (Ach.) Funck.
P. polydactyla (Neck.) Hoffm.
P. rufescens (Weis.) Humb.
P. scabrosa Th. Fr.
Pertusaria bryontha (Ach.) Nyl.
P. dactylina (Ach.) Nyl.
P. panyrga (Ach.) Mass.
Phaeophyscia sciastra (Ach.) Moberg
Physcia caesia (Hoffm.) Fürnr.
Physconia muscigena (Ach.) Poelt
Polyblastia cupularis Mass.
P. gelatinosa Ach. (Th. Fr.)
Polychidium muscicola (Sw.) S. F. Gray
Polysporina urceolata (Anzi) Brodo
Porpidia flavocaerulescens (Hornem) Hertel & Schwab
P. macrocarpa (DC in Lam. & DC) Hertel & Schwab
P. thomsonii Gowan
Protoblastenia rupestris (Scop.) Steiner
Pseudephebe minuscula (Nyl. ex Arn.) Brodo & Hawksw.
Psora decipiens (Hedw.) Hoffm.
P. himalayana (Bab.) Timdal
Pyrenopsidium granuliforme (Nyl.) Forss.
Rhizocarpon alpicola (Hepp) Rabenh.
R. chioneum (Norm.) Th. Fr.
R. geminatum Körb.
R. geographicum (L.) DC.
R. hochstetteri (Körb.) Vainio
R. superficiale (Schaer.) Vainio
Rhizoplaca chrysoleuca (Sw.) Zopf
R. melanopthalma (Ram.) Leuck. & Poelt
Rinodina archaea (Ach.) Vainio
R. bischoffii (Hepp) Mass.
R. roscida (sommerf.) Arn.
R. turfacea (Wahl.) Körb.

Appendix 2. Continued.

Solorina bispora Nyl.
S. saccata (L.) Ach.
Sporastatia testudinea (Ach.) Mass.
Staurothele drummondii (Tuck.) Tuck.
Thamnolia subuliformis (Ehrh.) Culb.
T. vermicularis (Sw.) Ach. ex Schaer.
Thrombium epigaeum (Pers.) Wallr.
Toninia lobulata (Sofferf.) Lynge
Tremolecia atrata (Ach.) Hertel
Umbilicaria arctica (Ach.) Nyl.
U. hyperborea (Ach.) Hoffm.
U. torrefacta (Lightf.) Schrad.
U. virginis Schaer.
Verrucaria arctica Lynge
V. cataleptoides (Nyl.) Nyl.
V. deversa Vainio
V. muralis Ach.
Xanthoria elegans (Link.) Th. Fr.

Appendix 3. Vascular plants of the Melville Hills region, Northwest Territories.

POLYPODIACEAE
- *Cystopteris fragilis* (L.) Bernh.
- *Woodsia glabella* R.Br.

EQUISETACEAE
- *Equisetum arvense* L.
- *E. palustre* L.
- *E. scirpoides* Michx.
- *E. variegatum* Schleich.

LYCOPODIACEAE
- *Lycopodium selago* L.

PINACEAE
- *Juniperus communis* L.

SPARGANIACEAE
- *Sparganium hyperboreum* Laest.

POTAMOGETONACEAE
- *Potamogeton filiformis* Pers.
- *P. vaginatus* Turcz.

SCHEUCHZERIACEAE
- *Triglochin maritimum* L.
- *T. palustre* L.

GRAMINEAE
- *Arctagrostis latifolia* (R.Br.) Griseb.
- *A. latifolia* (R.Br.) Griseb. var. *arundinacea* (Trin.) Griseb.
- *Arctophila fulva* (Trin.) Anders.
- *Bromus pumpellianus* Scribn.
- *B. p.* Scribn. var. *arcticus* Shear) Porsild
- *Calamagrostis canadensis* (Michx.) Beauv. ssp. *langsdorfii* (Link) Hulten
- *C. purpurascens* R.Br.
- *C. stricta* (Timm) Koeler (*C. neglecta* (Ehrh.) Gaertn., Mey. & Scherb.)
- *Colpodium vahlianum* (Leibm.) Nevski
- *Deschampsia brevifolia* R.Br.
- *Dupontia fisheri* R.Br.
- *Elymus alaskanus* (Scribn. & Merr.) A. Löve ssp. *hyperarcticus* (Polunin) A. & D. Löve (*Agropyron violaceum* (Hornem.) Lange var. *hyperarcticum* Polunin)

Appendix 3. Continued.

Festuca altaica Trin.
F. baffinensis Polunin
F. brachyphylla Schultes & Schultes
F. richardsonii Hook. (*F. rubra* L. ssp. *richardsonii* (Hook.) Hulten)
F. vivipara (L.) Smith ssp. *glabra* Frederiksen
Hierochloe alpina (Sev.) R. & S.
H. pauciflora R.Br.
Leymus mollis (Trin.) Pilger ssp. *villosissimus* (Scribn.) A. Löve (*Elymus arenarius* L. ssp. *mollis* (Trin.) Hulten)
Poa alpigena (Fries) Lindm.
P. arctica R.Br.
P. glauca M. Vahl
Puccinellia andersonii Swallen
P. angustata (R.Br.) Rand & Redf.
P. borealis Swallen
P. deschampsioides Th. Sor.
P. langeana (Berl.) Th. Sor.
P. phryganodes (Trin.) Scribn. & Merr.
P. vaginata (Lange) Fern. & Weath.
Trisetum spicatum (L.) Richt.

CYPERACEAE
Carex aquatilis Wahlenb.
C. atrofusca Schk.
C. bicolor All.
C. capillaris L. s.lat.
C. chordorrhiza Ehrh.
C. glacialis Mack.
C. lugens Holm
C. maritima Gunn
C. membranacea Hook.
C. microglochin Wahlenb.
C. misandra R.Br.
C. nardina Fries
C. petricosa Dew.
C. rariflora (Wahlenb.) Sm.
C. saxatilis L.
C. scirpoidea Michx.
C. subspathacea Wormskj.
C. ursina Dewey
C. vaginata Tausch.
Eriophorum angustifolium Honckn.
E. callitrix Cham.
E. scheuchzeri Hoppe
E. triste (Th. Fr.) Hadac & Löve
E. vaginatum L.

Appendix 3. Continued.

Kobresia myosuroides (Vill.) Fiori & Paol.
K. simpliciuscula (Wahlenb.) Mack.
Scirpus caespitosus L. ssp. *austriacus* (Pallas) Asch. & Graebn.

JUNCACEAE
Juncus albescens (Lange) Fern.
J. arcticus Willd.
J. balticus L. var. *alaskanus* (Hulten) Porsild
J. biglumis L.
J. castaneus Smith
Luzula confusa Lindebl.
L. nivalis (Laest.) Beurl.

LILIACEAE
Tofieldia coccinea Richards.
T. pusilla (Michx.) Pers.
Zygadenus elegans Pursh

ORCHIDACEAE
Corallorhiza trifida Chat.
Habenaria obtusata (Pursh) Richards.

SALICACEAE
Salix alaxensis (Anders.) Cov.
S. arctica Pall.
S. brachycarpa L. spp. *niphoclada* (Rydb.) Argus (*S. niphoclada* Rydb.)
S. glauca L.
S. hastata L. (*S. farrae* Ball)
S. lanata L. ssp. *richardsonii* (Hook.) A. Skvortsov
S. phlebophylla Anders.
S. planifolia Pursh
S. polaris Wahlenb.
S. reticulata L.

BETULACEAE
Betula glandulosa Michx.

POLYGONACEAE
Polygonum viviparum L.
Oxyria digyna (L.) Hill
Rumex arcticus Trautv.

CHENOPODIACEAE
Suaeda calceoliformis (Hook.) Moq.

Appendix 3. Continued.

CARYOPHYLLACEAE

Arenaria humifusa Wahlenb.
Cerastium beeringianum C. & S.
C. regelii Ostenf.
Honkenya peploides L. var. *diffusa* Hornem.
Minuartia biflora (L.) Schinzl & Thell.
M. rossii (R.Br.) Graebn.
M. rubella (Wahlenb.) Hiern.
Silene acaulis L.
S. involucrata (C. & S.) Bocquet (*Melandrium affine* J. Vahl)
S. uralensis (Rupr.) Bocquet (*Melandrium apetalum* ssp. *arcticum* sensu Porsild & Cody (1980))
Stellaria humifusa Rottb.
S. longipes Goldie s.lat. (incl. *S. laeta* Richards. and *S. monantha* Hulten)

RANUNCULACEAE

Anemone parviflora Michx.
A. richarsonii Hook.
Caltha palustris L. var. *arctica* (R.Br.) Huth.
Ranunculus aquatilis L.
R. cymbalaria Pursh
R. gmelinii DC.
R. hyperboreus Rottb.
R. nivalis L.
R. pedatifidus Sm.
R. pygmaeus Wahl.

PAPAVERACEAE

Papaver cornwallisensis A. Löve
P. macounii Greene (*P. keelei* Porsild)

CRUCIFERAE

Braya glabella Richards.
B. humilis (C.A. Mey.) Robins.
B. purpurascens (R.Br.) Bunge
Cardamine digitata Richards.
C. pratensis L. ssp. *angustifolia* (Hook.) O.E. Schulz
Cochlearia officinalis L.
Descurainia sophioides (Fisch.) O.E. Schulz
Draba alpina L.
D. cinerea Adams
D. corymbosa R.Br. ex DC.
D. fladnizensis Wulf.
D. glabella Pursh
D. incerta Payson
D. subcapitata Simm.

Appendix 3. Continued.

Erysimum inconspicuum (S. Wats.) MacMill.
E. pallasii (Pursh) Fern.
Eutrema edwardsii R.Br.
Lesquerella arctica (Wormskj.) S. Wats.
Parrya arctica R.Br.

SAXIFRAGACEAE
Chrysosplenium tetrandrum (Lund) Fries
Parnassia kotzebuei C. & S.
P. palustris L. var. *neogaea* Fern.
Saxifraga aizoides L.
S. caespitosa L.
S. cernua L.
S. foliolosa R.Br.
S. hirculus L.
S. nivalis L.
S. oppositifolia L.
S. rivularis L.
S. tricuspidata Rottb.

ROSACEAE
Dryas integrifolia M. Vahl
D. sylvatica (Hulten) Porsild
Potentilla biflora Willd.
P. egedii Wormsjk.
P. fruticosa L. ssp. *floribonda* (Pursh) Elkington
P. hyparctica Malte var. *elatior* (Abrom.) Fern.
P. nivea L. var. *nipharga* (Rydb.) Sojak
P. palustris (L.) Scop.
P. prostrata Rottb. (*P. nivea* auct. non L.)
P. rubricaulis Lehmann (*P. rubricaulis* sensu Porsild & Cody pro parte)
P. vahliana Lehm.

LEGUMINOSAE
Astragalus alpinus L.
A. eucosmus Robins.
Hedysarum alpinum L. var. *americanum* Michx.
H. mackenzii Richards.
Lupinus arcticus S. Wats.
Oxytropis arctica R.Br.
O. arctobia Bunge
O. deflexa (Pall.) DC. var. *foliolosa* (Hook.) Barneby
O. maydelliana Trautv. ssp. *melanocephala* (Hook.) Porsild
O. varians (Rydb.) K. Schum

LINACEAE
Linum lewisii Pursh

Appendix 3. Continued.

EMPETRACEAE
- *Empetrum nigrum* L. var. *hermaphroditum* (Lge.) Böcher

ELAEAGNACEAE
- *Shepherdia canadensis* (L.) Nutt.

ONAGRACEAE
- *Epilobium angustifolium* Honckn.
- *E. latifolium* L.

HALORAGACEAE
- *Hippuris vulgaris* L.

PYROLACEAE
- *Pyrola grandiflora* Radius
- *P. secunda* L.

ERICACEAE
- *Andromeda polifolia* L.
- *Arctostaphylos rubra* (Rehd. & Wils.) Fern.
- *Cassiope tetragona* (L.) D.Don
- *Ledum decumbens* (Ait.) Lodd.
- *Rhododendron lapponicum* (L.) Wahlenb.
- *Vaccinium uliginosum* L.
- *V. vitis-idaea* var. *minus* Lodd.

PRIMULACEAE
- *Androsace chamaejasme* Host. var. *arctica* Knuth
- *A. septentrionalis* L.
- *Primula egaliksensis* Wormsk.
- *P. stricta* Hornem.

PLUMBAGINACEAE
- *Armeria maritima* (Mill.) Willd. ssp. *labradorica* (Wallr.) Hulten

GENTIANACEAE
- *Gentiana propinqua* Richards.
- *G. prostrata* Haenke
- *G. detonsa* Rottb. ssp. *detonsa* (*G. richardsonii* Porsild)
- *Lomatogonium rotatum* (L.) Fries

POLEMONIACEAE
- *Phlox richardsonii* Hook.

BORAGINACEAE
- *Mertensia drummondii* (Lehm.) G.Don

Appendix 3. Continued.

SCROPHULARIACEAE
- *Castilleja caudata* (Pennell) Rebr.
- *C. elegans* Malte
- *C. hyperborea* Pennell
- *Pedicularis arctica* R.Br.
- *P. capitata* Adams
- *P. flammea* L.
- *P. lanata* C. & S.
- *P. sudetica* Willd.

LENTIBULARIACEAE
- *Pinguicula vulgaris* L.

PLANTAGINACEAE
- *Plantago canescens* Adams
- *P. maritima* L. ssp. *juncoides* (Lam.) Hulten (*P. juncoides* var. *glauca* sensu Porsild & Cody (1980))

CAMPANULACEAE
- *Campanula uniflora* L.

COMPOSITAE
- *Achillea nigrescens* (E. Mey.) Rydb.
- *Antennaria angustata* Greene
- *A. compacta* Greene
- *A. ekmaniana* Porsild

- *Arnica alpina* (L.) Olin ssp. *angustifolia* (J. Vahl) Maguire
- *A. louiseana* Farr. ssp. *frigida* (Meyer ex Ilgin) Maguire
- *Artemisia borealis* Pall.
- *A. hyperborea* Rydb.
- *A. tilesii* Ledeb.
- *Aster pygmaeus* Lindl.
- *A. sibiricus* L.
- *Chrysanthemum arcticum* L.
- *C. integrifolium* Richards.
- *Crepis nana* Richards.
- *Erigeron compositus* Pursh
- *E. eriocephalus* J. Vahl
- *E. humilis* Grah.
- *Senecio atropurpureus* (Ledeb.) Fedtsch.
- *S. hyperborealis* Greenm.
- *S. lugens* Richards.
- *Solidago multiradiata* Ait.
- *Taraxacum alaskanum* Rydb.
- *T. dumetorum* Greene
- *T. pumilum* Dahlst.

Appendix 4. Mammals confirmed to occur in the Melville Hills region.

This list includes all mammals recorded within 50 km of the proposed Bluenose National Park. We used the following sources. (1) Kelsall's (1970) published notes from a one-month field trip at Bluenose Lake in 1953. (2) Unpublished notes from a team of the University of British Columbia (C.J. Krebs, A. Kenney, D. Garnier, C. Bergman and D. Reid) following four three-month periods (June to August) at Pearce Point, in 1987-1990. Sightings were recorded within 10 km of Pearce Point. (3) Notes from an unpublished report (Obst 1990) to the Canadian Parks Service that summarizes observations made in 1988 and 1990 during a one-month journey along the Hornaday River. (4) Information collected from Paulatuk hunters between January 1988 and August 1991 for the Inuvialuit Harvest Study (Fabijan 1991abcd). The number of animals taken between January 1988 and August 1991 is given. They were given confirmed status as many if not most animals were likely killed in or within 50 km of the proposed park, as suggested by maps in the Paulatuk Conservation Plan (Anon. 1990). (5) Our observations throughout and near the proposed park, between 24 July and 2 August 1990. We give the number of animals that we saw. The Bowhead Whales were seen at Clinton Point by G. Hamre, Canadian Parks Service, while we were at another site in the proposed park.

Species	Kelsall 1970	UBC 1987-1990	Obst 1990	Fabijan 1991	Our observations 1990
Arctic Hare *Lepus arcticus*	Fecal pellets found.	Rare resident	Rare	-	-
Arctic Ground Squirrel *Spermophilus parryii*	Abundant	Common resident	Common	-	35
Brown Lemming *Lemmus sibiricus*	Skulls found in Snow Owl pellets.	Rare resident	-	-	-
Collared Lemming *Dicrostonyx torquatus*	Few seen but burrows abundant.	Common resident	-	-	-
Muskrat *Ondatra zibethicus*	-	-	-	1	-
Tundra Vole *Microtus oeconomus*	Extremely abundant	Common resident	-	-	-
White Whale (Beluga) *Delphinapterus leucas*	-	-	-	21	-
Bowhead Whale *Balaena mysticetus*	-	-	-	-	3
Wolf *Canis lupus*	Scarce	Occasional visitor	Rare, 1 den found	130	-
Arctic Fox *Alopex lagopus*	Common, several dens found.	Skull and other remains found.	-	271	1
Red Fox *Vulpes vulpes*	-	Uncommon resident	Rare, 1 den found	148	5; 1 den found
Grizzly Bear *Ursus arctos*	2 sightings, many signs present.	Occasional visitor	Rare	7	11
Polar Bear *Ursus maritimus*	-	-	-	34	-

Appendix 4. Continued.

Species	Kelsall 1970	UBC 1987-1990	Obst 1990	Fabijan 1991	Our observations 1990
American Marten Martes americana	-	-	-	175	-
Ermine Mustela erminea	Abundant	Uncommon resident	Rare, in Gyrfalcon prey remains.	16	-
American Mink Mustela vison	-	-	-	5	-
Wolverine Gulo gulo	-	-	-	60	-
Bearded Seal Erignathus barbatus	-	Uncommon on spring coastal ice.	-	14	-
Ringed Seal Phoca hispida	-	Common on spring coastal ice.	-	275	-
Caribou Rangifer tarandus	Common	Common seasonally	Common	2021	271
Moose Alces alces	-	-	-	3	-
Muskox Ovibos moschatus	Uncommon	Very rare	Uncommon	33	64

Appendix 5. Mammals that probably occur in the Melville Hills region.

This list includes all mammals that may occur in or within 50 km of the proposed Bluenose National Park. It includes mostly forest and marine species that were confirmed to occur further west, in the Anderson-Horton rivers area (Zoltai *et al*. 1979). Since this area includes the western edge of the Melville Hills, species that were mentioned in that report but that were not confirmed to occur within 50 km of the proposed park, were considered of probable occurrence. Marine mammals recorded in the eastern Beaufort Sea or western Amundsen Gulf are considered probable near the Melville Hills, as their occurrence is just as probable in southeastern Amundsen Gulf. In light of a recent taxonomic review of shrews, only the comments of van Zyll de Jong (1983) were considered for these species.

Species	Banfield 1974	Zoltai *et al*. 1979	Rugh & Fraker 1981	van Zyll de Jong 1983
Tundra Shrew *Sorex tundraensis*	-	-	-	East to Anderson River
Common Shrew *Sorex cinereus*	-	-	-	North to treeline
Barrenground Shrew *Sorex ugyunak*	-	-	-	Mainland NWT, north of treeline
Snowshoe Hare *Lepus americanus*	North to treeline	Rare	-	-
American Red Squirrel *Tamasciurus hudsonicus*	North to treeline	Rare	-	-
American Beaver *Castor canadensis*	North to treeline	Rare	-	-
Northern Red-backed Vole *Clethrionomys gapperi*	Usually in shrubs or open taiga.	Unknown	-	-
Meadow Vole *Microtus pennsylvanicus*	North to treeline	Rare	-	-
Chestnut-cheeked Vole *Microtus xanthognathus*	North to treeline	Rare	-	-
American Porcupine *Erethizon dorsatum*	North to treeline	Rare	-	-
Killer Whale *Orcinus orca*	Rare visitor in Beaufort Sea.	Rare	-	-
Gray Whale *Eschrictus robustus*	-	-	Up to 3 in eastern Beaufort Sea.	-
American Black Bear *Ursus americanus*	North to treeline	Rare	-	-
Least Weasel *Mustela nivalis*	North to treeline	Rare	-	-
River Otter *Lontra canadensis*	North to treeline	Rare	-	-

Appendix 5. Continued.

Species	Banfield 1974	Zoltai *et al.* 1979	Rugh & Fraker 1981	van Zyll de Jong 1983
Northern Fur Seal *Callorhinus ursinus*	1 in Franklin Bay.	-	-	-
Walrus *Odobenus rosmarus*	A few records in western Arctic.	Rare	-	-
Harbour Seal *Phoca vitulina*	East to eastern Beaufort Sea.	-	-	-

Appendix 6. Birds confirmed to occur in the Melville Hills region.

This list includes all birds recorded in or within 50 km of the proposed Bluenose National Park. The following sources were used. (1) Kelsall's (1970) published notes from a one-month field trip at Bluenose Lake in 1953. (2) Unpublished notes from a team of the University of British Columbia (C.J. Krebs, A. Kenney, D. Garnier, C. Bergman and D. Reid) following five three-month (June to August) periods at Pearce Point, in 1987-1991. Sightings were made within 10 km of Pearce Point. (3) An unpublished report (Obst 1990) to the Canadian Parks Service summarizing observations made in 1988 and 1990 during a one-month journey along the Hornaday River, and unpublished notes from J. Obst from a one-month journey along the Brock River in July 1991. (4) Information collected between January 1988 and August 1991 for the Inuvialuit harvest study (Fabijan 1991abcd). As suggested by the Paulatuk Conservation Plan (Anon. 1990), many birds were apparently killed within 50 km of the proposed park. (5) Our observations throughout and near the proposed park, between 24 July and 2 August 1990. (6) Unpublished notes from aerial surveys of waterfowl carried out by J.E. Hines and S.E Westover, Canadian Wildlife Service, in June 1991.

The abundance and status of a species was often determined subjectively. When data were available, birds that were recorded five times or less in one year were considered rare (R), those recorded between five and 25 times uncommon (U), and those recorded more than 25 times common (C). When nests, eggs or young were observed, a species was a confirmed breeder (B). When no evidence of nesting was found but breeding was suspected, it was designated a probable breeder (b). Species observed only during migration were designated migrants (M), whereas non-breeding species observed during the summer were designated transients (T).

Species	Kelsall 1970	UBC 1987-1991	Obst 1990-91	Fabijan 1991	Our observations 1990	Hines & Westover 1991
Red-throated Loon *Gavia stellata*	U-B	U-B	U-B	-	U-b	U-b
Pacific Loon *Gavia pacifica*	C-B	C-b	C	C	C-B	R-b
Common Loon *Gavia immer*	-	R-T	-	C	-	-
Yellow-billed Loon *Gavia adamsii*	C-B	U-b	R-B	C	U-b	-
Tundra Swan *Cygnus columbianus*	C-B	U-B	C-B	C	C-B	U-b
Greater White-fronted Goose *Anser albifrons*	-	U-M	R	C	-	R-b
Snow Goose *Chen caerulescens*	-	C-M	-	C	-	-
Ross' Goose *Chen rossii*	-	-	-	R	-	-
Brant *Branta bernicla*	-	U-M	-	U	-	U-b

Appendix 6. Continued.

Species	Kelsall 1970	UBC 1987-1991	Obst 1990-91	Fabijan 1991	Our observations 1990	Hines & Westover 1991
Canada Goose *Branta canadensis*	U-M	C-B	C-B	C	C-B	C-b
Green-winged Teal *Anas crecca*	-	R-T	U	-	-	R-b
Mallard *Anas platyrhyncos*	R-T	-	R	-	U-T	R
Northern Pintail *Anas acuta*	C	U-b	U	U	C-B	C-b
American Wigeon *Anas americana*	-	R-T	U	-	-	-
Canvasback *Aythya valisineria*	-	-	-	R	-	-
Greater Scaup *Aythya marila*	-	-	R	-	U-B	-
Lesser Scaup *Aythya affinis*	-	-	C	-	-	-
Common Eider *Somateria mollissima*	-	C-B	R	-	C-b	R-b
King Eider *Somateria spectabilis*	U-B	U-B	-	-	R-b	-
Oldsquaw *Clangula hyemalis*	C-B	C-M	C	C	C-B	C-b
Surf Scoter *Melanitta perspicillata*	-	U	U	-	-	-
White-winged Scoter *Melanitta fusca*	-	R-T	U	-	C	U
Common Merganser *Mergus merganser*	-	U	C	-	C	R
Red-breasted Merganser *Mergus serrator*	U-B	U-B	U	-	C-b	R
Bald Eagle *Haliaeetus leucocephalus*	-	-	-	-	R-T	-
Northern Harrier *Circus cyaneus*	-	R-T	-	-	-	-
Rough-legged Hawk *Buteo lagopus*	U-B	C-B	C-B	-	U-B	-
Golden Eagle *Aquila chrysaetos*	R	C-B	C-B	-	U-b	-
Merlin *Falco columbarius*	-	-	R-B	-	-	-
Peregrine Falcon *Falco peregrinus*	R	C-B	C-B	-	C-B	-
Gyrfalcon *Falco rusticolus*	-	R-T	U-B	-	R-b	-

Appendix 6. Continued.

Species	Kelsall 1970	UBC 1987-1991	Obst 1990-91	Fabijan 1991	Our observations 1990	Hines & Westover 1991
Willow Ptarmigan *Lagopus lagopus*	C-B	R-T	C-b	-	U-B	-
Rock Ptarmigan *Lagopus mutus*	C-B	R-T	U-b	-	R-b	-
Sandhill Crane *Grus canadensis*	-	U-T	R	-	-	U
Black-bellied Plover *Pluvialis squatarola*	U-M	R	-	-	-	-
Lesser Golden-Plover *Pluvialis dominica*	C-B	U-B	C-B	-	C-B	R-b
Semipalmated Plover *Charadrius semipalmatus*	-	C-B	C-B	-	U-b	-
Lesser Yellowlegs *Tringa flavipes*	-	R-T	R	-	-	-
Spotted Sandpiper *Actitis macularia*	-	-	R-b	-	-	-
Ruddy Turnstone *Arenaria interpres*	-	R-M	-	-	-	-
Sanderling *Calidris alba*	U-M	R-M	-	-	R-T	-
Semipalmated Sandpiper *Calidris pusilla*	C-M	C-B	R	-	C-B	-
Least Sandpiper *Calidris minutilla*	-	U-B	C-B	-	R-b	-
White-rumped Sandpiper *Calidris fuscicollis*	R-M	-	-	-	R-B	-
Baird's Sandpiper *Calidris bairdii*	C-B	C-B	C	-	R-T	-
Pectoral Sandpiper *Calidris melanotos*	U-B	-	U	-	U-T	-
Stilt Sandpiper *Calidris himantopus*	-	R-B	R	-	R-T	-
Buff-breasted Sandpiper *Tryngites subruficollis*	R	R-T	-	-	R-b	-
Sommon Snipe *Gallinago gallinago*	-	-	R	-	-	-
Red-necked Phalarope *Phalaropus lobatus*	U-T	R-B	U	-	U-B	-
Red Phalarope *Phalaropus fulicaria*	-	R-T	-	-	-	-
Pomarine Jaeger *Stercorarius pomarinus*	-	U-T	-	-	-	-
Pararitic Jaeger *Stercorarius parasaticus*	C-B	R-T	R	-	U-T	-

Appendix 6. Continued.

Species	Kelsall 1970	UBC 1987-1991	Obst 1990-91	Fabijan 1991	Our observations 1990	Hines & Westover 1991
Long-tailed Jaeger *Stercorarius longicaudus*	C-T	U-b	U	-	U-T	R
Bonaparte's Gull *Larus philadelphia*	-	-	Prey remain of Peregrine Falcon	-	-	-
Hering Gull *Larus argentatus*	C-B	-	U	-	C-B	-
Thayer's Gull *Larus thayeri*	-	C-B	U	-	U-b	-
Glaucus Gull *Larus hyperboreus*	U-B	C-B	U	-	C-B	-
Sabine's Gull *Xema sabini*	-	R-T	-	-	-	-
Arctic Tern *Sterna paradisaea*	C-B	U-T	C	-	C-b	-
Snowy Owl *Nyctea scandiaca*	C-B	Regurgitation pellets	-	-	R-T	-
Short-eared Owl *Asio flammeus*	R-T	R-T	R-B	-	R-T	R
Say's Phoebe *Sayornis saya*	-	R-T	U	-	R-b	-
Horned Lark *Eremophila alpestris*	-	C-B	C-B	-	C-B	-
Bank Swallow *Riparia riparia*	-	R-T	-	-	-	-
Cliff Swallow *Hirundo pyrrhonota*	-	-	U	-	R-b	-
Common Raven *Corvus corax*	R-T	C-B	U-B	-	U-b	R
Northern Wheatear *Oenanthe oenanthe*	-	-	R-B	-	-	-
American Robin *Turdus migratorius*	-	R-b	U-B	-	-	-
American Pipit *Anthus rubescens*	C-M	C-B	C-B	-	C-B	-
Yellow Warbler *Dendoica petechia*	-	-	R	-	-	-
Yellow-rumped Warbler *Dendroica coronata*	-	-	R	-	-	-
American Tree Sparrow *Spizella arborea*	R	-	C-B	-	U-b	-

Appendix 6. Continued.

Species	Kelsall 1970	UBC 1987-1991	Obst 1990-91	Fabijan 1991	Our observations 1990	Hines & Westover 1991
Savannah Sparrow *Passerculus sandwichensis*	-	R-T	R	-	U-B	-
Lincoln's Sparrow *Melospiza lincolnii*	-	-	-	-	R-b	-
White-crowned Sparrow *Zonotrichia leucophrys*	-	U-B	C-B	-	U-B	-
Harris' Sparrow *Zonotrichia querula*	-	R-T	U	-	-	-
Lapland Longspur *Calcarius lapponicus*	C-B	C-B	C-B	-	C-B	-
Snow Bunting *Plectrophenax nivalis*	C-b	C-B	C-B	-	U-b	-
Common Redpoll *Carduelis flammea*	-	-	C-B	-	C-B	-
Hoary Redpoll *Carduelis hornemanni*	-	U-b	C-B	-	U-B	-

Sources of North American English names and scientific names: AOU 1983, 1985, 1989.

Appendix 7. Fish species captured in the Melville Hills region.

Species	Sutherland & Golke 1978	MacDonell 1986	MacDonell 1989	Fabijan 1991
Arctic Lamprey *Lampreta japonica*			X	
Pacific Herring *Clupea harengus*				X
Arctic Char *Salvelinus alpinus*	X	X	X	X
Lake Trout *Salvelinus namaycush*	X			X
Lake Cisco *Coregonus artedii*	X			X[a]
Arctic Cisco *Coregonus autumnalis*		X	X	X[a]
Least Cisco *Coregonus sardinella*	X			X[a]
Lake Whitefish *Coregonus clupeaformis*	X			X
Broad Whitefish *Coregonus nasus*	X	X	X	X
Round Whitefish *Prosopium cylindraceum*	X			X
Inconnu *Stenodus leucichthys*			X	X
Arctic Grayling *Thymallus arcticus*	X	X	X	X
Pond Smelt *Hypomesus olidus*	X			
Arctic Rainbow Smelt *Osmerus mordax dentex*	X			
Northern Pike *Esox lucius*	X			X
Saffron Cod *Eleginus navaga*				X
Arctic Cod *Boreogadus saida*				X
Burbot *Lota lota*	X			X
Nine-spine Stickleback *Pungitius pungitius*	X			
Slimy Sculpin *Cottus cognatus*	X			
Four-horned Sculpin *Myoxocephalus quadricornis*	X			

[a] Unidentified cisco species reported by Fabijan (1991abcd) may include this species.

Appendix 8. Species of mammals, birds and fish taken and reported by Paulatuk hunters, 1988-1991.

Mammals	Jan. - Dec. 88	Jan. - Dec. 89	Jan. - Dec. 90	Jan. - Aug. 91
Hare sp.	5	-	2	-
Muskrat	1	-	-	-
Beluga	-	6	-	15
Wolf	43	32	13	42
Arctic Fox	184	6	65	16
Red Fox	81	34	33	-
Grizzly Bear	-	4	-	3
Polar Bear	7	10	11	6
American Marten	77	92	5	1
Ermine	16	-	-	-
American Mink	4	-	1	-
Wolverine	19	19	14	8
Bearded Seal	5	4	5	-
Ringed Seal	55	101	95	24
Seal sp.	4	-	-	-
Caribou	665	405	659	292
Moose	1	1	1	-
Muskox	5	14	5	9

Fish	Jan. - Dec. 88	Jan. - Dec. 89	Jan. - Dec. 90	Jan. - Aug. 91
Pacific Herring	38	104	125	115
Arctic Char	2991	2988	2736	1986
Lake Trout	440	227	215	347
Cisco sp.	253	25	90	10
Lake Whitefish	412	696	30	20
Broad Whitefish	1722	2277	876	419
Whitefish sp.	44	-	-	-
Inconnu	1	-	-	-
Arctic Grayling	10	20	-	-
Northern Pike	2	-	-	-
Burbot	4	2	1	1
Arctic Cod	-	-	-	6
Saffron Cod	-	60	10	500

Appendix 8. Continued.

Birds	Jan. - Dec. 88	Jan. - Dec. 89	Jan. - Dec. 90	Jan. - Aug. 91
Common Loon	6	8	4	-
Yellow-billed Loon	2	-	-	1
Tundra Swan	27	35	39	42
Greater White-fronted Goose	377	322	431	279
Lesser Snow Goose (white)	1507	865	929	1189
Lesser Snow Goose (blue)	3	2	3	2
Ross' Goose	-	2	2	1
Brant	23	17	18	-
Canada Goose	334	203	310	227
Northern Pintail	12	2	-	-
Scaup sp.	12	-	-	-
Eider sp.	35	21	14	6
Oldsquaw	187	45	8	21
Scoter sp.	1	-	-	-
Merganser sp.	12	1	-	2
Ptarmigan sp.	971	366	341	132
Sandhill Crane	-	6	10	10

Sources: Fabijan 1991abcd.

Appendix. 9 Species classified by the Committee on the Status of Endangered Wildlife in Canada that occur in the Melville Hills region.

Species	Status* (year of designation)	Comment (for more information see text)
Polar Bear *Ursus maritimus*	Vulnerable (1991)	Population apparently stable but vulnerable by nature of its biology, response to environmental change, and potential over-hunting. The population of eastern Beaufort Sea/Amundsen Gulf is apparently in good condition.
Grizzly Bear *Ursus arctos horribilis*	Vulnerable (1991)	Most populations in Canada are either vulnerable or threatened, but that of the Arctic Coastal Plains, which includes this region, is not considered at risk. It was designated "Not in any category".
Wolverine *Gulo gulo*	Vulnerable (1989)	Status applies to western Canadian population. Species characterized by low density and reproductive rate. Can be easily over-hunted. However, the regional population appears healthy and its status needs to be better defined.
Bowhead Whale *Balaena mysticetus*	Endangered (1986)	The population of the North American western Arctic is larger than previously thought, and is growing. Status needs reassessment.
Eskimo Curlew *Numenius borealis*	Endangered (1978)	Few individuals are apparently still alive. The Melville Hills region is part of their probable nesting range (Gollop *et al*. 1986). Recent sightings were recorded as close as the Anderson River Delta and Lac Rendez-vous. No known record for the Melville Hills.
Peregrine Falcon *Falco peregrinus tundrius*	Vulnerable (1992)	Nests commonly in the Melville Hills. Was designated threatened in 1978.

* Vulnerable: Any indigenous species of fauna or flora that is particularly at risk because of low or declining numbers, occurrence at the fringe of its range or in restricted areas, or for some other reason, but is not a threatened species.

Threatened: Any indigenous species of fauna or flora that is likely to become endangered in Canada if the factors affecting its vulnerability do not become reversed.

Endangered: Any indigenous species of fauna or flora that is threatened with imminent extinction or extirpation throughout all or a significant portion of its Canadian range.

Source: COSEWIC 1991 and C.C. Shank (pers. comm.).